Progress Report

March 16, 2016

Steam Enhanced Extraction at the Former Williams AFB, ST012 Site

Mesa, AZ

1. Summary

This report covers the period of operations from Tuesday, March 8, 2016 through Monday, March 14, 2016. The following table provides a summary of the project operational status.

Table 1. Project Summary

	Value	Unit
Target Treatment Zone (TTZ) Soil Volume	410,000	cubic yards (cy)
Area	199,000	square feet (ft^2)
Upper Depth of Treatment	145	feet (ft) below ground surface (bgs)
Lower Depth of Treatment	245	ft bgs
Vapor Liquid Treatment Started	09/29/14	
Thermal Operations Started	09/29/14	
Last Process Data Update	03/14/16	
Last Temperature Data Update	03/14/16	
Estimated Total Days of Operation	422	days
Days of Operation	532	days
Days of Operation vs. Estimate	126	percent (%)
Estimated Total Energy Usage	11,343,000	kilowatt hours (kWh)
Total Energy Used	5,504,463	kWh
Used Electrical Energy vs. Estimate	49	%
Total Steam Injected	302.4	million pounds (lbs)
Projected Total Steam Injection	320	million lbs
Steam Injected Vs Projected	94	%
Total Mass Removed in Vapor Based on Photoionization Detector (PID) Readings	1,113,053	lbs
Total Mass Removed as NAPL	1,352,433	lbs
Average Daily NAPL Mass Removal Last Week	1,475	lbs/day
Total Vapor and Liquid Mass Removal (based on PID readings)	2,465,486	lbs
Average Power Usage Rate Last Week	492	kilowatts (kW)
Average Wellfield Vapor Extraction Rate Last	411	standard cubic feet per minute (scfm)
Average Condensate Production Rate Last Week	0.5	gallons per minute (gpm)
Average Water Extraction Rate Last Week	144	gpm
Total Water Extracted	86,287,139	gallons
Total Recovered Light Non-Aqueous Phase Liquid	205,850	gallons
Average Water Discharge Rate Last Week	178	gpm
Total Treated Water Discharge	114,686,000	gallons

Operational highlights from the past week include:

- The site wide depressurization that was initiated on Friday, March 4, 2016, continues.
- The average liquid extraction rate from the formation was approximately 151 gpm.
- Collected process, wellfield and laboratory samples per the sampling schedule.
- Conducted regular maintenance on the treatment system.
- The following MPE wells will require maintenance:
    - CZ08*
    - CZ11*
    - CZ12*
    - LSZ-11

**Temperatures at these MPE wells are at boiling – well maintenance will be postponed until temperatures are below boiling due to health and safety concerns.*

2. Vapor Extraction

Figure 1 below shows the vapor extraction rate from the site. Note that the estimated steam extraction rate is a calculated value based on the water generated at the moisture separators after cooling the vapors from the wellfield. Based on energy balance analysis, additional steam is likely being pulled into and condensing in the liquid extraction system. This steam extraction is not measureable and not accounted for in Figure 1. Additionally the wellfield flow is calculated as the difference between the air stripper flows and thermal accelerator influent, and is therefore only an estimate.

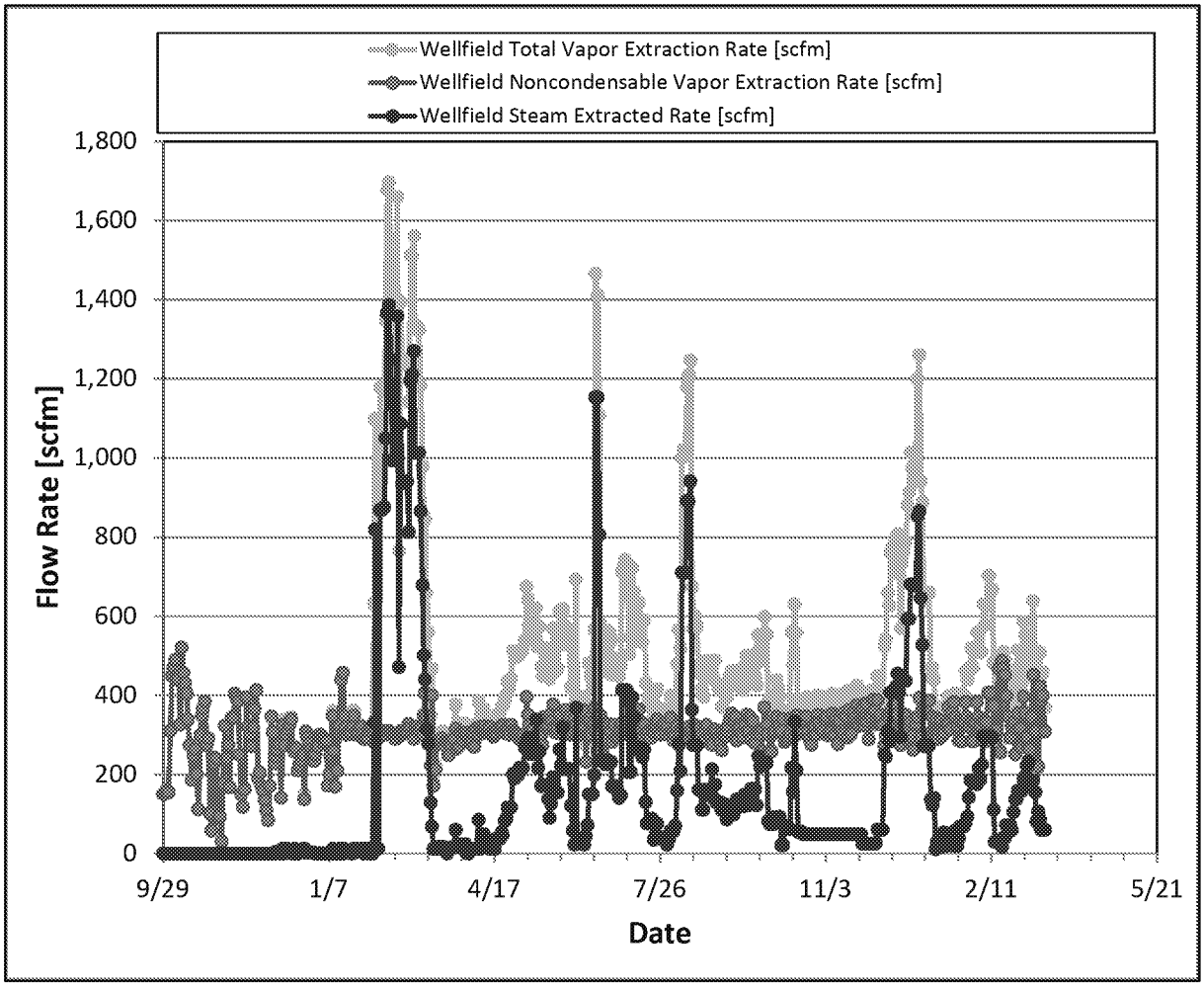

Figure 1. Vapor Extraction Rate

Note: Well SVE01M was tied into the SEE extraction system on June 5, 2015. Wells SVE10M and SVE14M were tied into the SEE extraction system on September 23, 2015.

3. PID Measurements

The following figure depicts the PID concentrations from the wellfield effluent to the effluent of the thermal accelerators collected since the start of operations. Note that PID readings of 0.0 parts per million by volume (ppmV) are shown in the figures as 0.01 ppmV due to the logarithmic scale that does not allow display of 0-values. Accelerator influent readings are interpolated for days where no data is collected, since the value is used in the mass removal calculation.

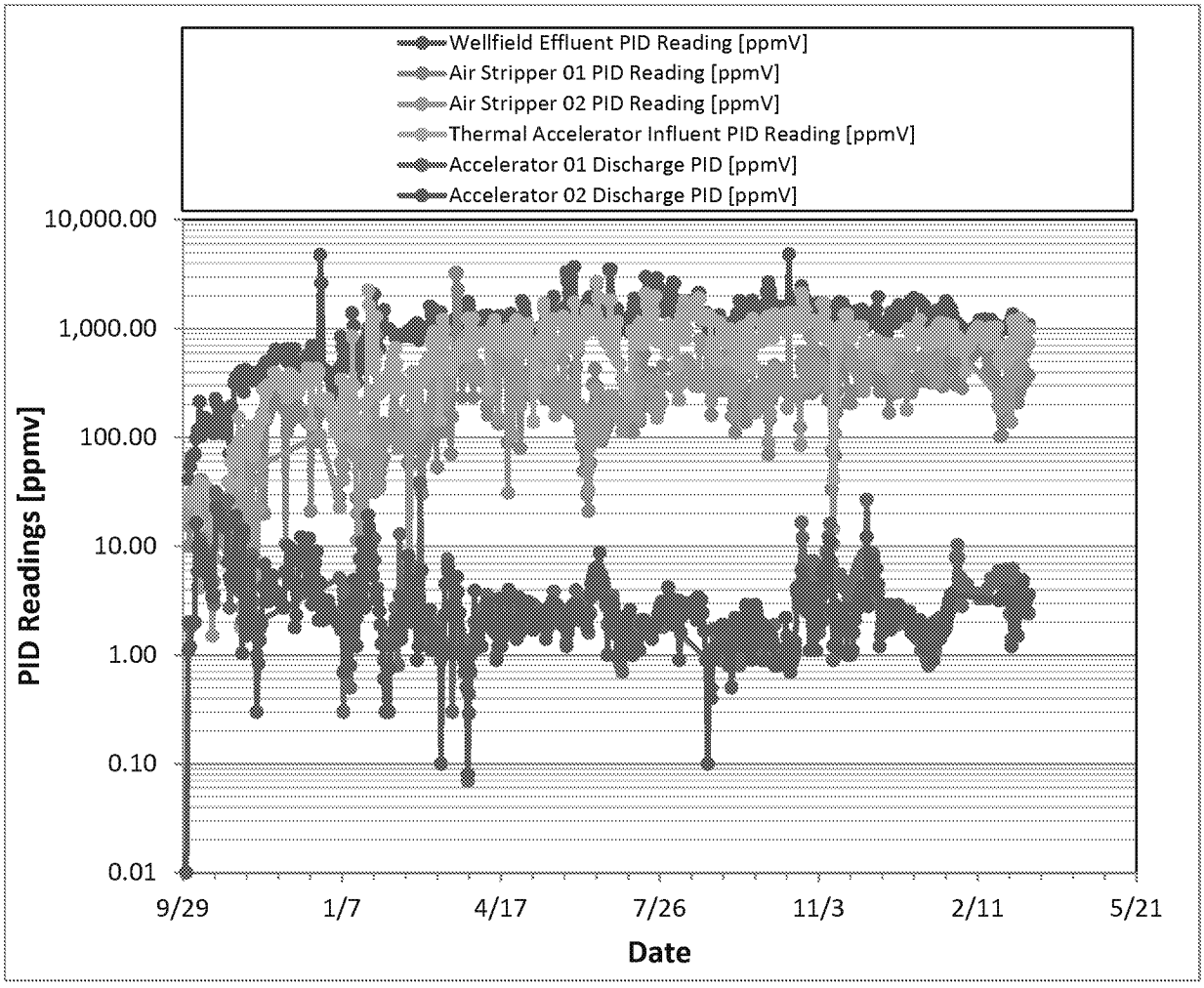

Figure 2. PID Readings

4. Mass Removal

The mass removal is calculated based on the PID and laboratory data collected at the thermal accelerator influent and the LNAPL recovered. The figure also depicts the mass removed based on PID and laboratory data.

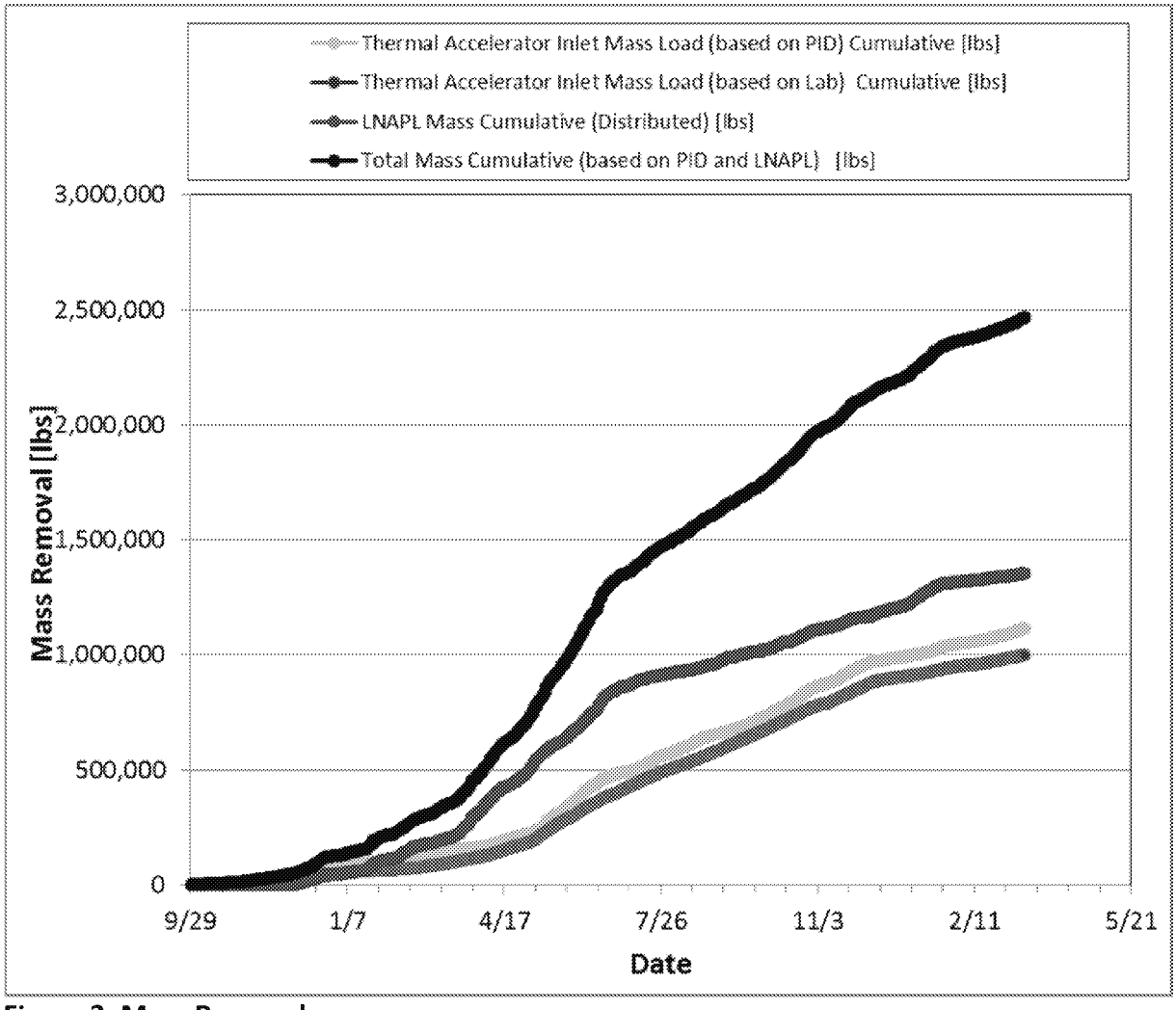

Figure 3. Mass Removal

Note: A NAPL density of 6.57 lbs/gallon is used to convert the NAPL volume to pounds. A molecular weight of 106.168 g/mol (corresponding to xylene) is used to convert PID readings to concentrations.

5. Daily Mass Removed

Figure 4 outlines the daily mass removed as vapor and LNAPL. The total daily mass removed is the combination of vapor and LNAPL. The liquid mass removal is captured in the vapor phase due to the volatilization of liquid contaminants in the air strippers.

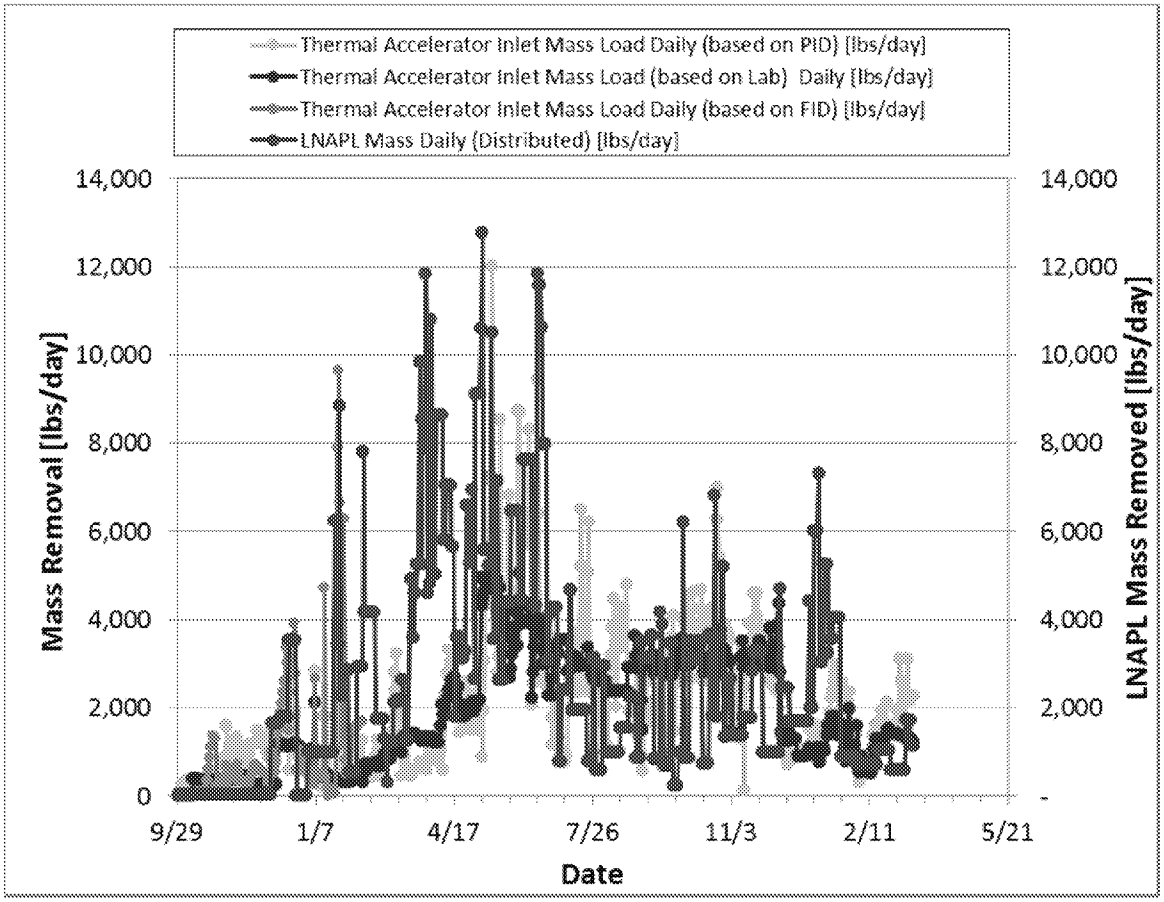

Figure 4. Daily Mass Removed

Note: Laboratory data are not collected daily. The "Thermal Accelerator Inlet Mass Load (based on lab)" is an average daily rate of actual laboratory data results received. The report has been updated based on laboratory data results received for samples collected through February 24, 2016 (please note that the February 11, 2016 correction factor looks to be biased low and is not thought to be a representative sample; it has not been used in the mass removal calculations).

Note that accumulated LNAPL is pumped through the NAPL conditioning system in a batch style process. The LNAPL daily mass removal rate has been calculated by calculating an average daily rate based on the total gallons processed for each batch over the number of days between batches.

6. Power Usage

The cumulative power usage is shown below. All electricity used at the site is utilized to run the process system and steam generators.

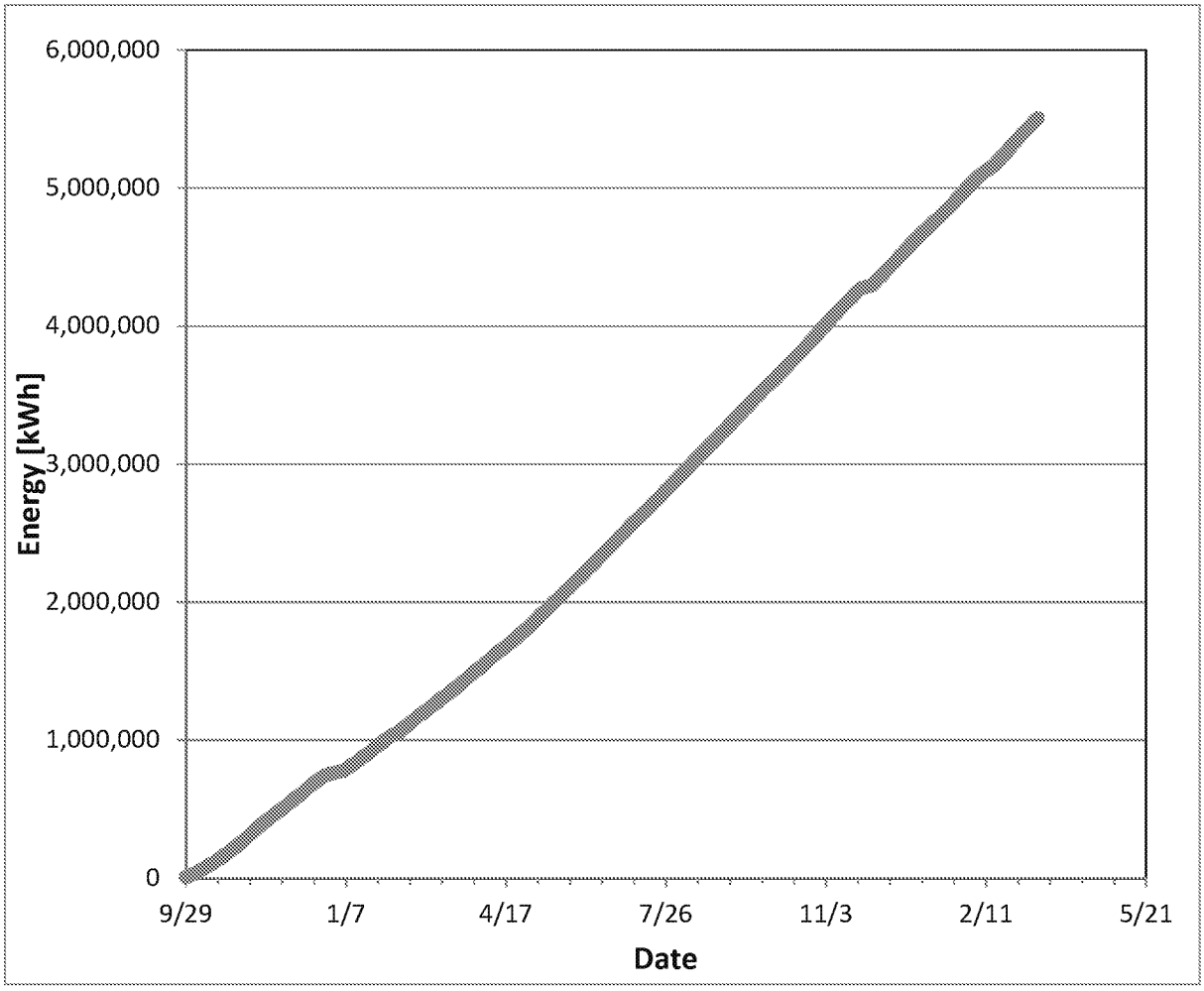

Figure 5. Cumulative Power Usage

7. Average Temperature

A detailed review of thermocouple sensor depths and temperatures over time was performed week ending November 13, 2015. Results of the review and updates are detailed below in Table 2 and Figure 6.

Table 2. Temperature Monitoring Sensor History

Temperature Monitoring Point	Temperature Monitoring Sensor History
TMP01	Well compromised 6/9/2015, select sensors back online 7/15/2015. Well not extended down in the Lower Permeable Zone (LPZ) and LSZ.
TMP03	Well compromised 12/18/15. All sensors offline as of 12/18/15.
TMP04	Well compromised 6/21/2015. Not included in LPZ and LSZ since 6/21/2015.
TMP05	Well compromised 5/6/2015, select sensors back online 7/15/2015. Sensors deeper than 160 ft have not been online since 5/6/2015 and therefore are not included in UWBZ, LPZ and LSZ.
TMP06	Well compromised 3/27/2015, select sensors back online 7/14/2015.
TMP07	Well compromised 3/27/2015, select sensors back online 7/14/2015.
TMP08	Well partly compromised 9/11/2015 from 210 ft and down. The 215 and 235 ft sensors are still operating.
TMP09	Well compromised 2/9/2015 before CZ was turned on and UWBZ was up to temperature. The CZ and UWBZ temperatures have been excluded. LSZ temperatures have not been updated since 2/9/2015 (taken out of LSZ average).
TMP12	Sensors from 150 to 170 ft bgs only at ~50C. Brings down the average in CZ and UWBZ.
TMP13	Well compromised 3/27/2015, select sensors back online 4/30/2015. Since 7/1/2015 no sensor deeper than 225 ft has been operational.
TMP15	Well compromised 8/15/2015. 8/15/2015 temperatures assumed from this day.
TMP17	Well compromised 3/27/2015, select sensors back online 6/12/2015 but not reporting properly, total failure 7/16/2015. Depths lower than 235 ft not included in average since well was not at temperature when sensors failed. 7/16/2015 temperatures applied to average since well failed.

The average soil temperatures as degrees Celsius (°C) and degrees Fahrenheit (°F) are shown in the figure below by treatment zone (i.e., LSZ, UWBZ and CZ).

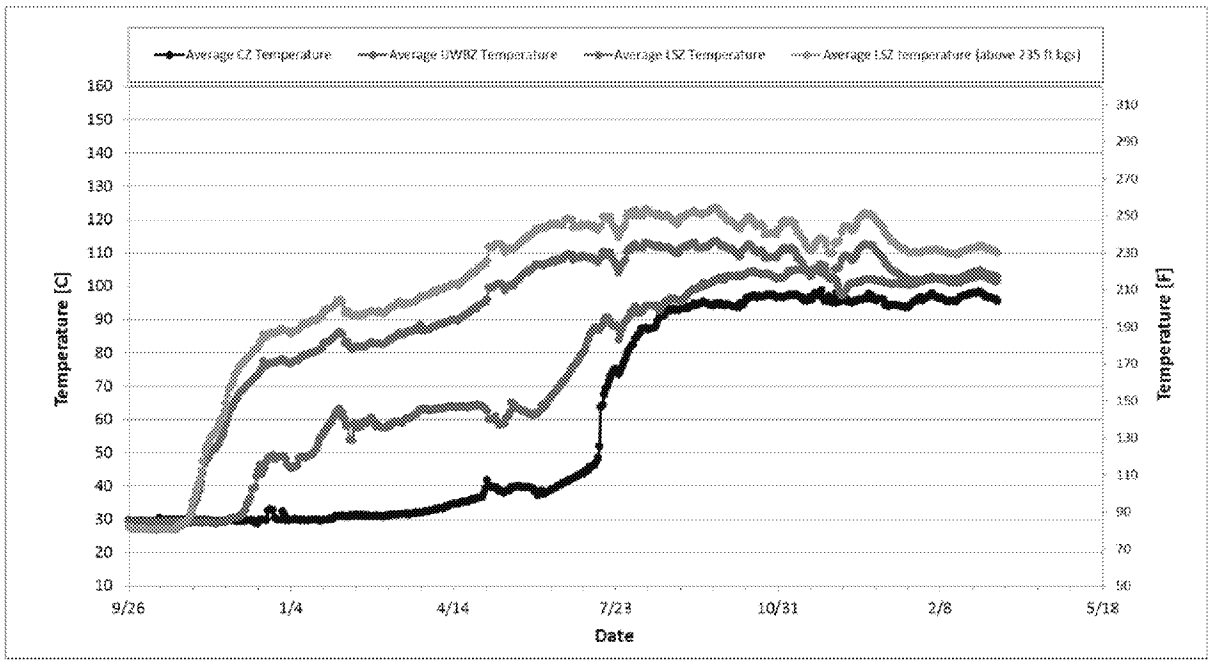

Figure 6. Average Soil Temperatures

Table 3 below provides a breakdown of the maximum average temperatures achieved at individual temperature monitoring points throughout SEE operations. The table below breaks down the average temperatures achieved across the CZ, UWBZ, Lower Permeability Zone (LPZ) and the LSZ to date. The LSZ is further broken down into the average for all LSZ sensors and those LSZ sensors above 235 ft bgs.

Table 3. Temperature Monitoring Point Maximum Depth-Averaged Temperature

	Temperature Monitoring Point Maximum Depth-Averaged Temperature[1] (°C) During SEE Operations by Zone				
Temperature Monitoring Point	**CZ**	**UWBZ**	**LPZ**	**LSZ**	**LSZ (depths above 235 ft bgs)**
TMP01	114.9	130.5	N/A	N/A	N/A
TMP03	N/A	N/A	137.5	114.2	120.7
TMP04	N/A	N/A	103.8	118.8	127.1
TMP05	110.3	N/A	N/A	N/A	N/A
TMP06	N/A	N/A	137.4	135.0	135.9
TMP07	N/A	N/A	134.6	137.2	140.2
TMP08	N/A	N/A	136.6	131.3	135.4
TMP09	N/A	N/A	132.5	134.1	139.3
TMP11	N/A	N/A	110.6	119.1	131.7
TMP12	78.2	93.6	121.8	121.4	131.3
TMP13	102.1	119.8	130.6	138.4	140.0
TMP14	N/A	N/A	133.6	124.3	136.3
TMP15	113.1	123.3	128.7	126.5	135.6
TMP16	N/A	N/A	126.7	120.5	131.0
TMP17	N/A	N/A	135.2	136.9	136.9
Maximum depth-averaged by zone[2]	**103.7**	**116.8**	**128.4**	**127.5**	**134.0**

If N/A, Temperature Monitoring Point has no sensors in that zone

[1] Temperature of the thermocouples across each depth zone are averaged for each TMP and each available time interval and then the maximum value of those averages throughout operations is listed in the table.

[2] Average of maximum depth-averages listed above for all TMPs in each zone.

8. Vertical and Horizontal Temperature Profiles

The following Figures 7 and 8 show the temperature in °C versus depth profiles for each of the 17 individual temperature monitoring points. Please see Table 2 for an updated temperature monitoring sensor status.

Temperature highlights for the past week include:

- Temperatures in the CZ and UWBZ at TMP 01 decreased slightly. The current high temperature for this array is 125°C at the 194 ft bgs depth.
- A temperature decrease was observed at the 215 ft bgs sensor at perimeter well TMP 02 and the array is currently 52°C at that depth.
- An approximate 5°C temperature decrease in the CZ was observed at TMP 05.
- Slight temperature decreases were observed in the UWBZ and LSZ at TMP 08.
- Perimeter well TMP-10 remains relatively stable over the large majority of the array, while a significant temperature increase was observed at the 242 ft bgs depth.
- An approximate 10°C temperature decrease was observed in the UWBZ at TMP 11.

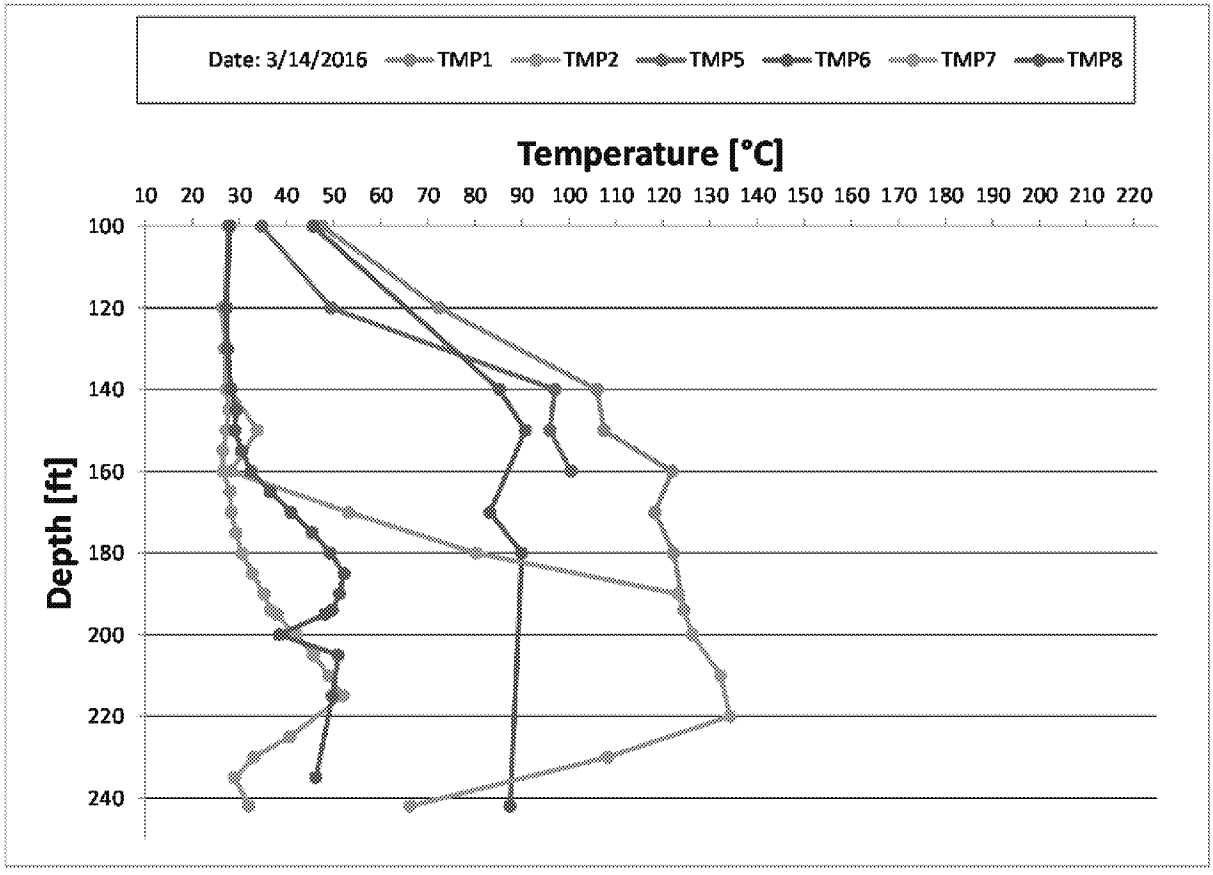

Figure 7. Vertical Temperature Profiles (TMP01 through TMP08)

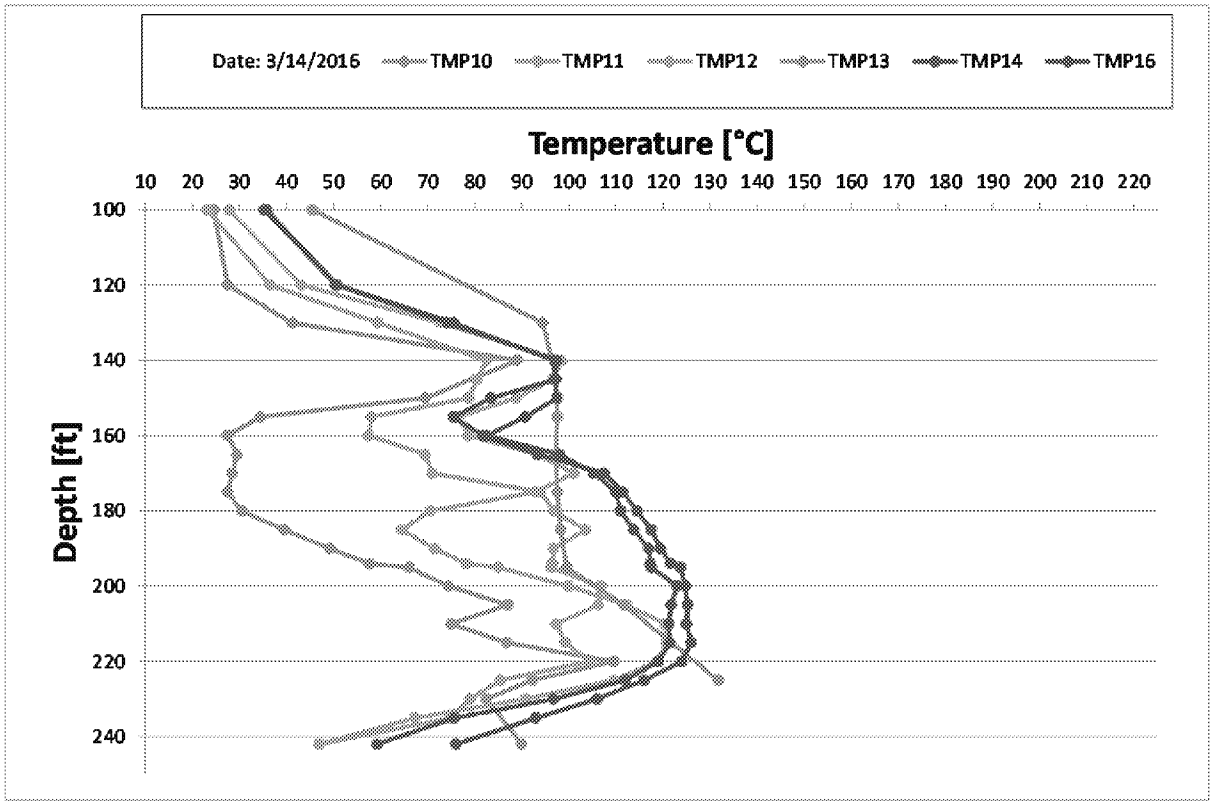

Figure 8. Vertical Temperature Profiles (TMP09 through TMP17)

Figures 9-12 show the horizontal temperature distribution across the site in four depth intervals.

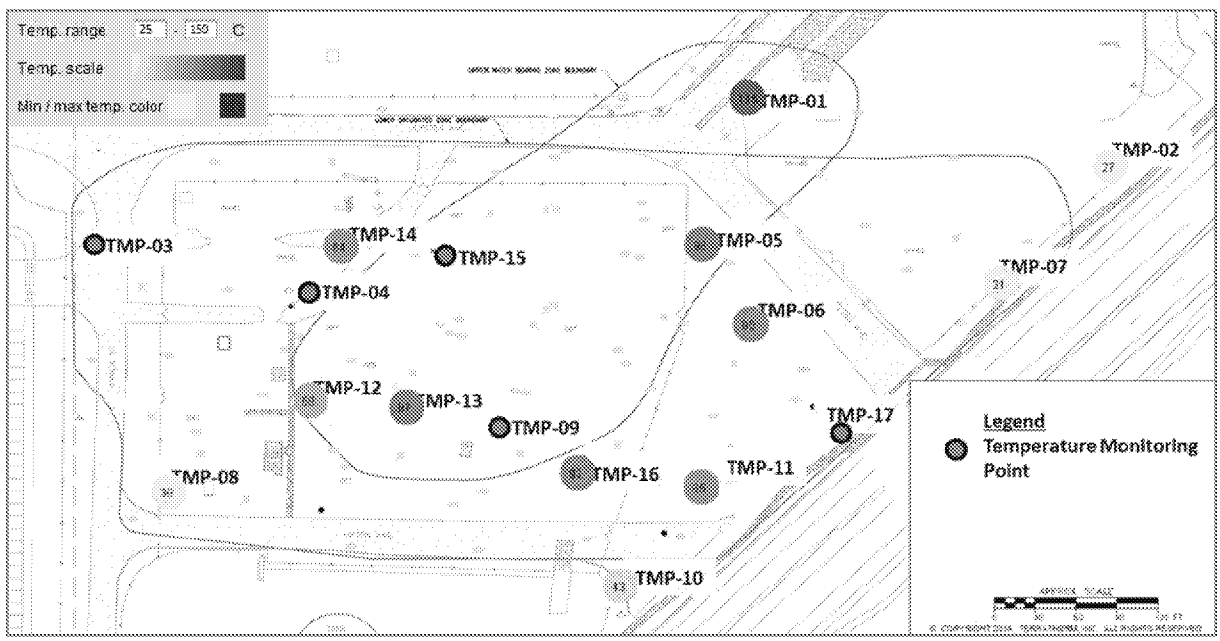

Figure 9. Horizontal Temperature Distribution across the CZ (145-160 ft bgs) (temperatures shown in °C)

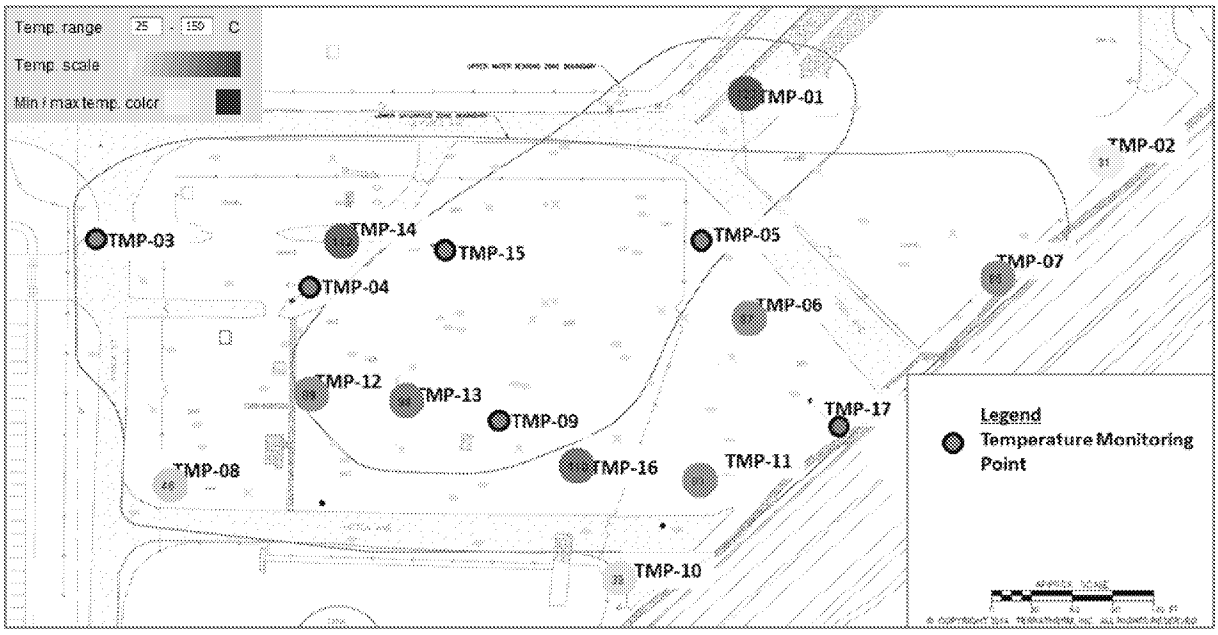

Figure 10. Horizontal Temperature Distribution across the UWBZ (161-195 ft bgs) (temperatures shown in °C)

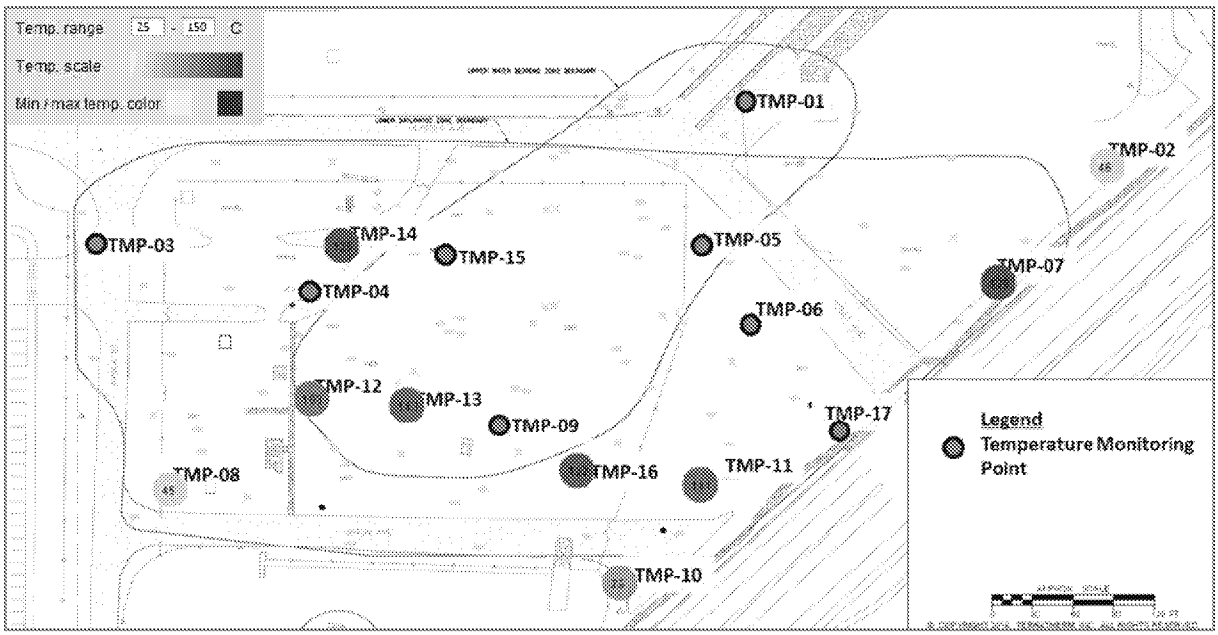

Figure 11. Horizontal Temperature Distribution across the Lower Permeable Zone (196-210 ft bgs) (temperatures shown in °C)

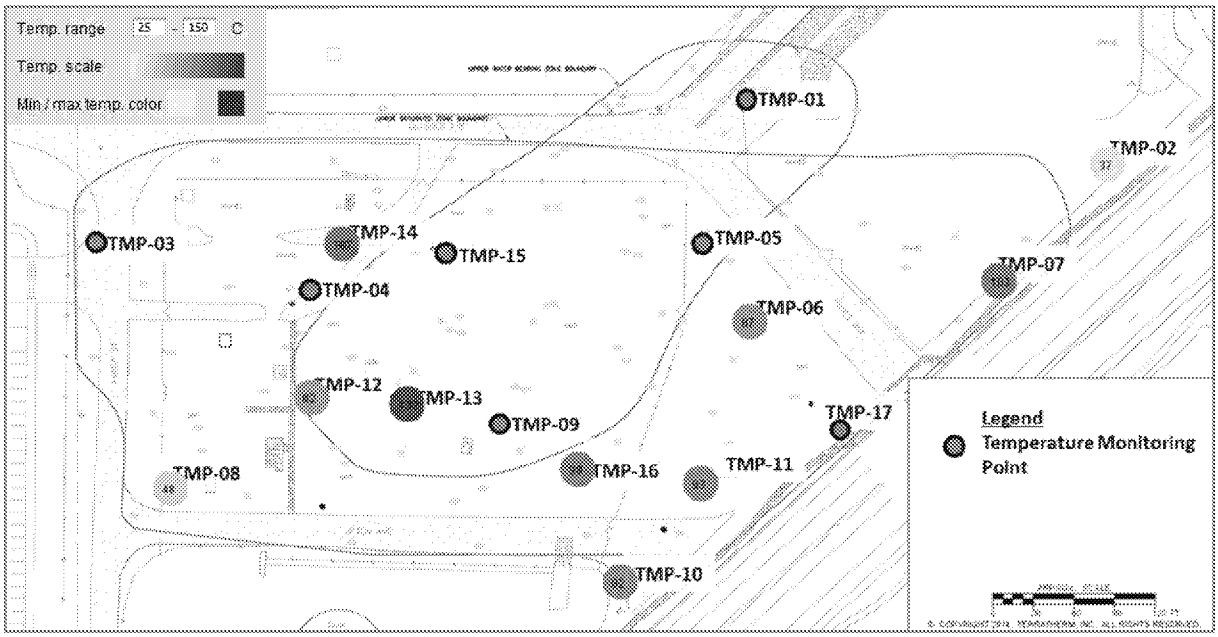

Figure 12. Horizontal Temperature Distribution across the LSZ (211-245 ft bgs) (temperatures shown in °C)

Figure 13 below shows the observed temperatures by depth at selected LSZ extraction wells.

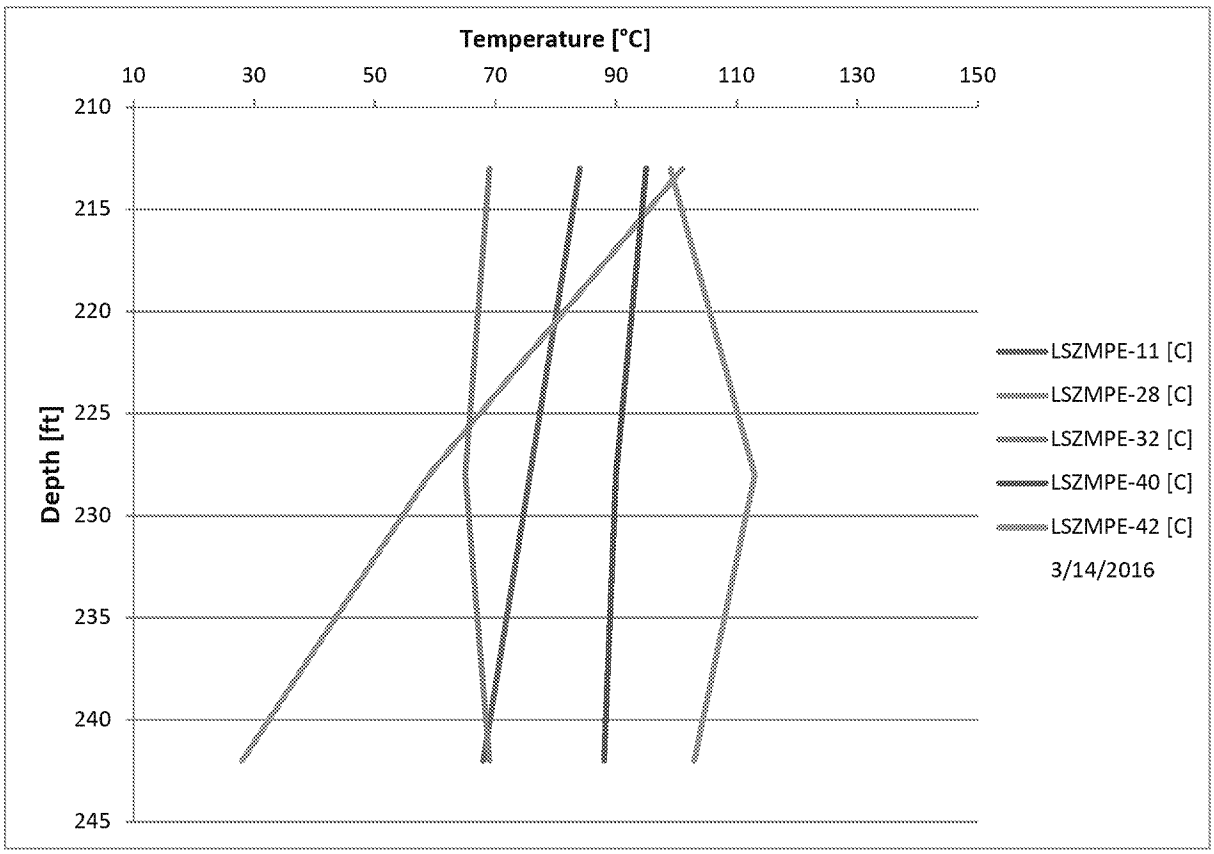

Figure 13. Temperatures by Depth at Selected LSZ Extraction Wells (211-245 ft bgs) (temperatures shown in °C)

9. Cumulative Steam Injection

Steam injection was initiated Thursday, October 16, 2014. Figure 14 below shows the cumulative steam injection for each of the three injection zones.

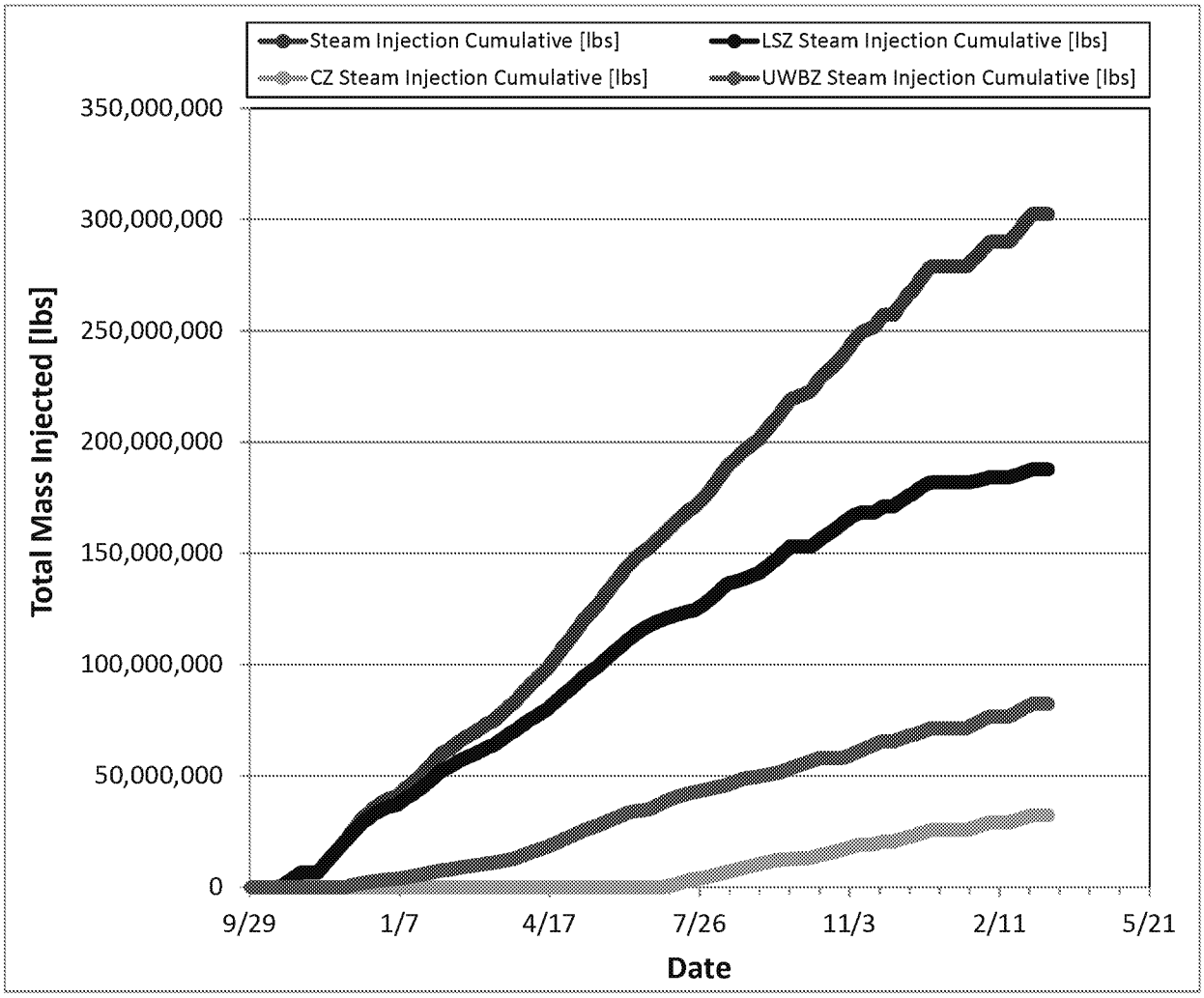

Figure 14. Cumulative Steam Injection for Each of the Three Injection Zones

10. Steam Injection Rates

The figure below shows the steam injection rates for each of the three injection zones.

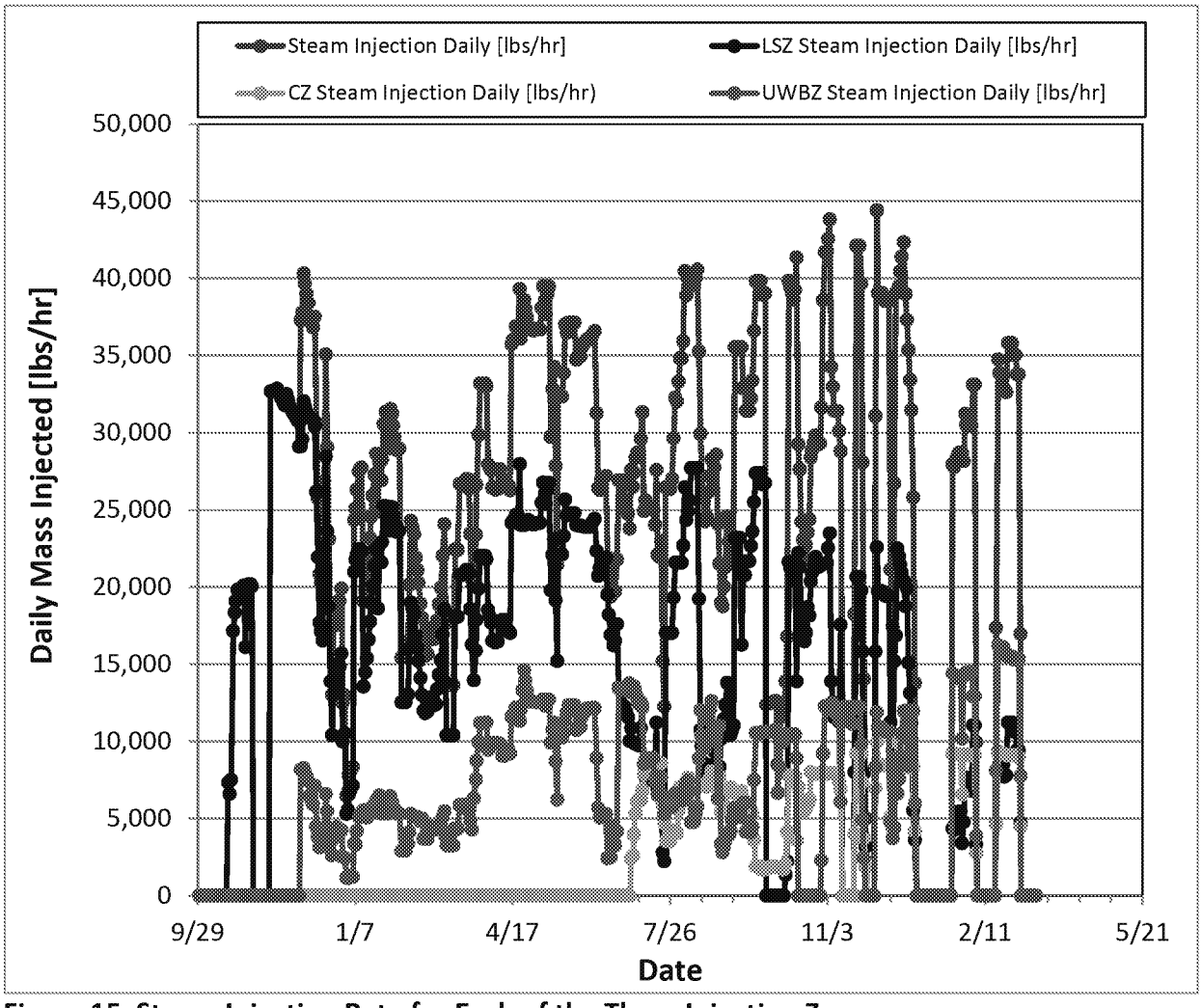

Figure 15. Steam Injection Rate for Each of the Three Injection Zones

11. Cumulative Water Extraction by Zone

The cumulative water extraction for each of the three treatment zones is shown below. The cumulative water extraction is calculated based on flow meters installed at each of the 57 extraction wells (accuracy should be considered +/- 20%). The figure below shows the net liquid extracted from the subsurface at the site and does not include the fraction of water that is recirculated to the eductor wells and used as motive water.

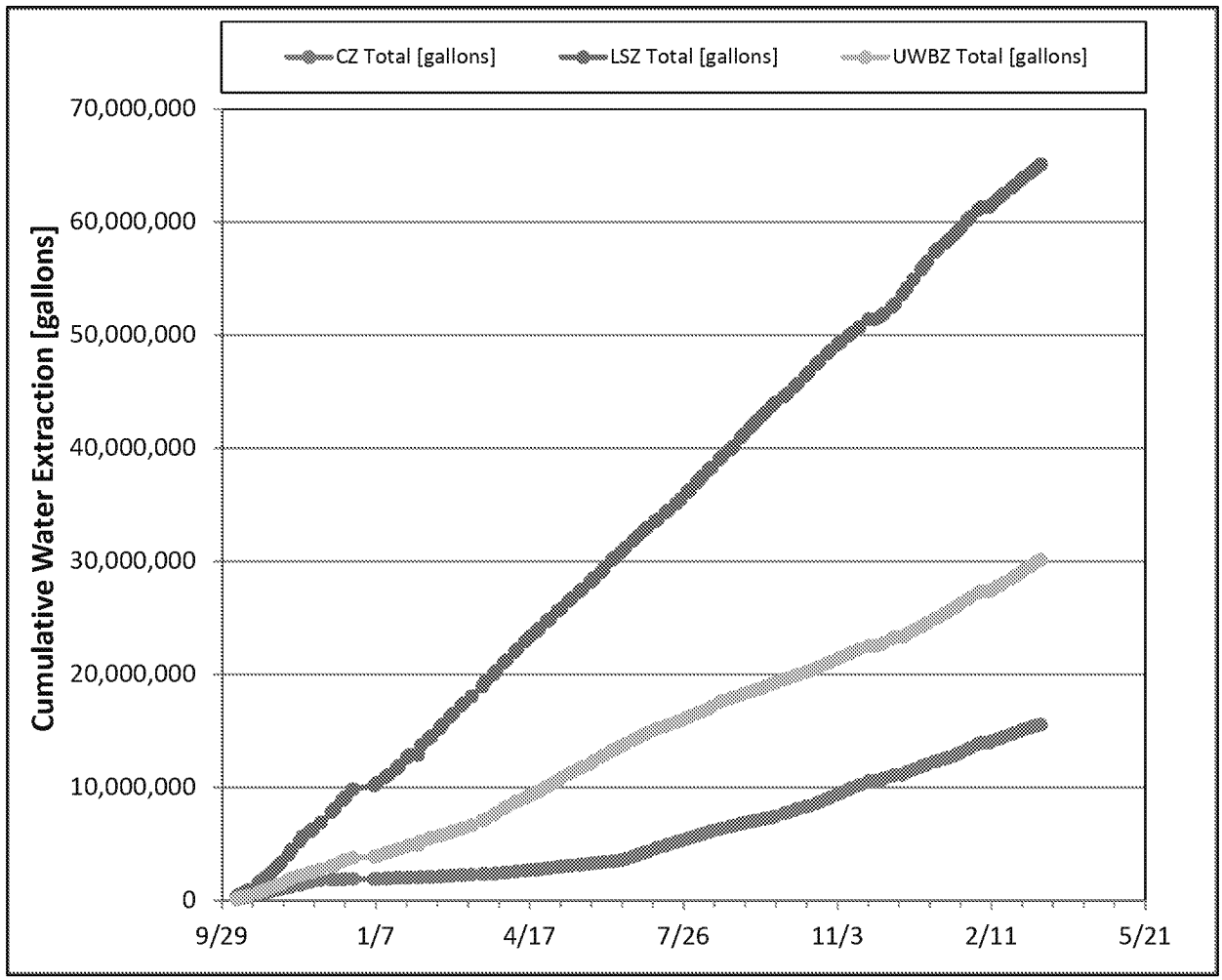

Figure 16. Cumulative Water Extraction for Each of the Three Treatment Zones

12. Water Extraction Rates by Zone

The figure below shows the water extraction rates for each of the three treatment zones.

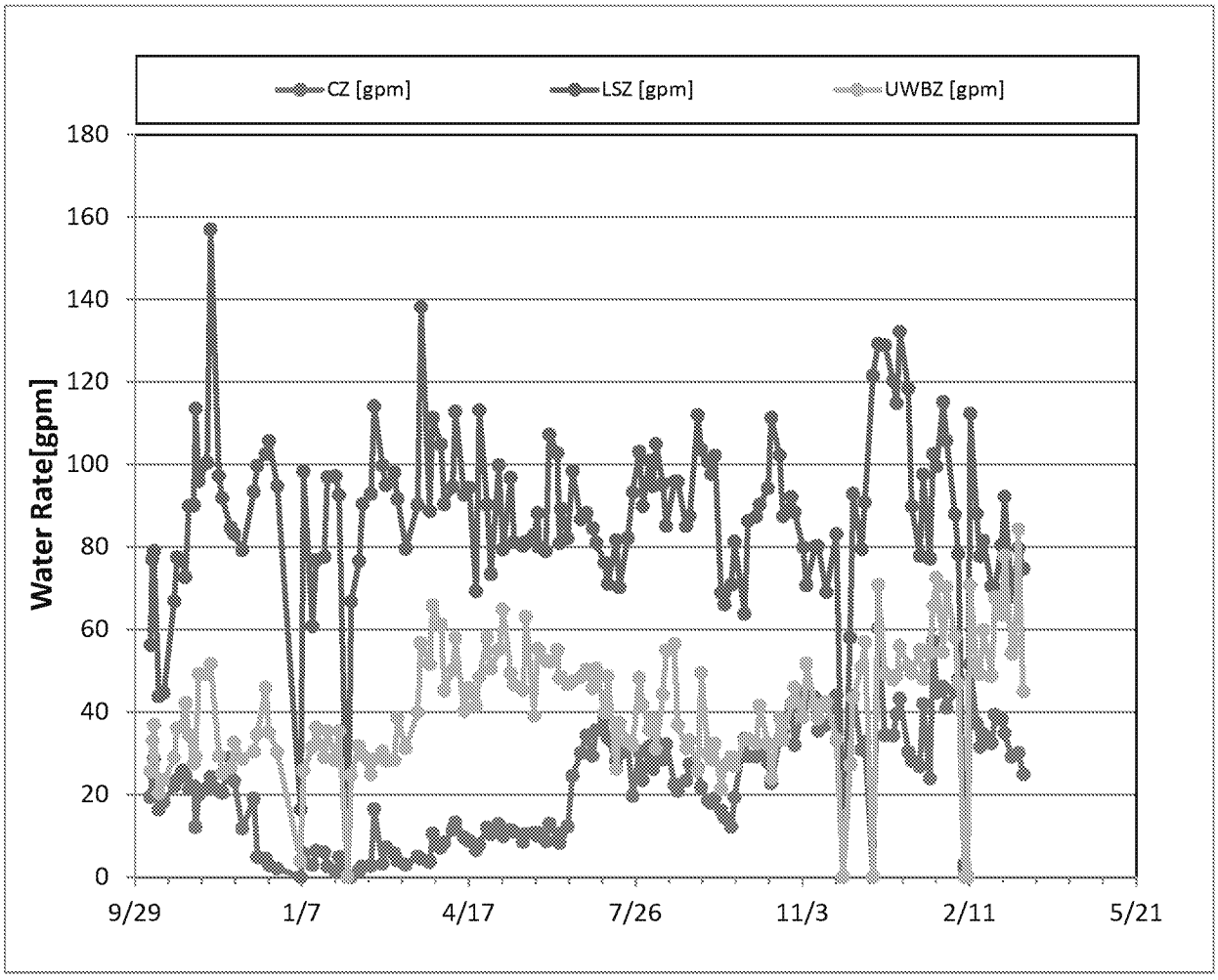

Figure 17. Water Extraction Rates for Each of the Three Treatment Zones

13. Cumulative Water Balance

The cumulative water balance for the site is shown below. The chart shows the net liquid extracted from the subsurface at the site and does not include the fraction of water that is recirculated to the eductor wells and used as motive water.

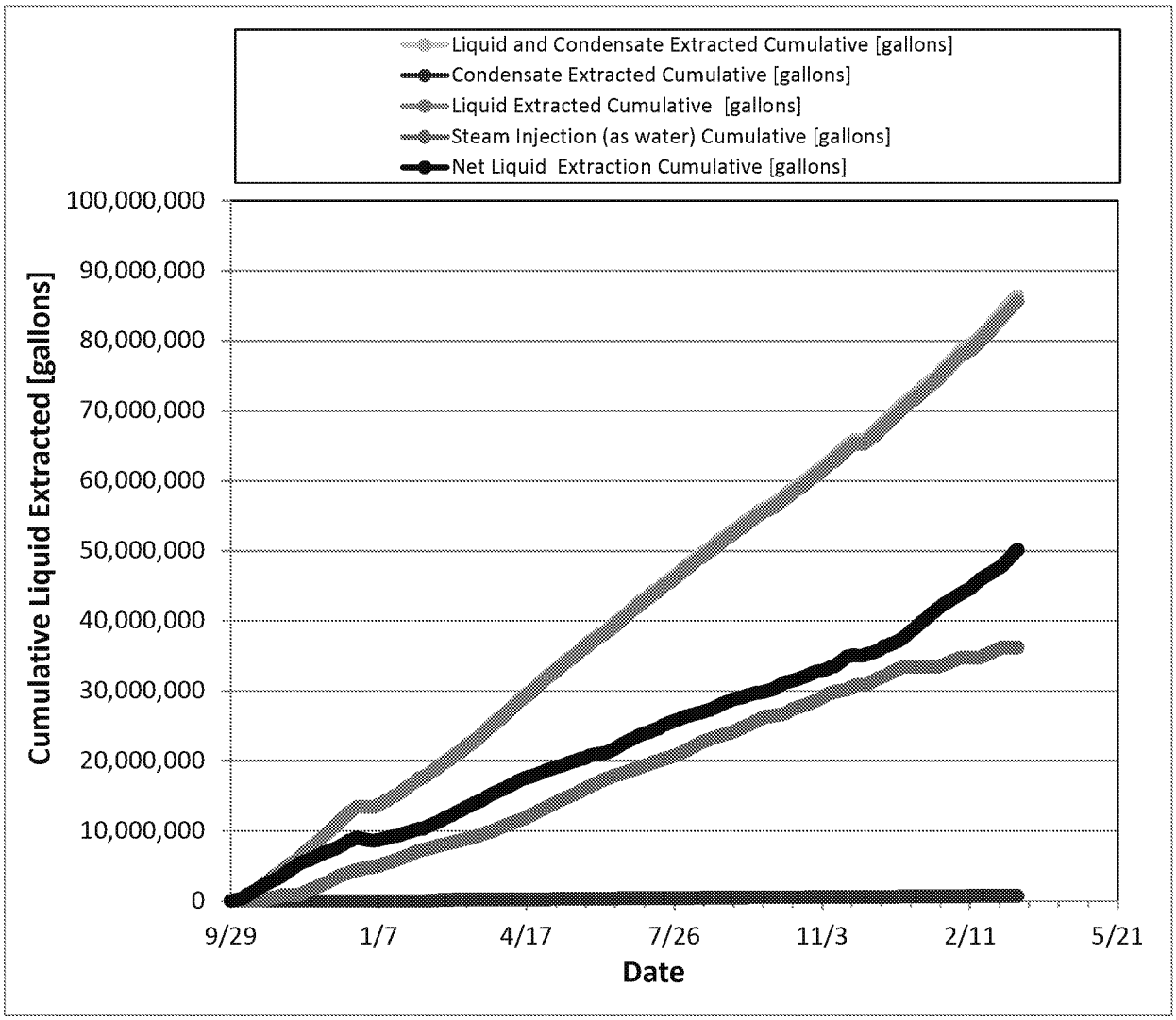

Figure 18. Cumulative Water Balance

14. Water Balance Rate

The total system water extraction rates are shown in the figure below.

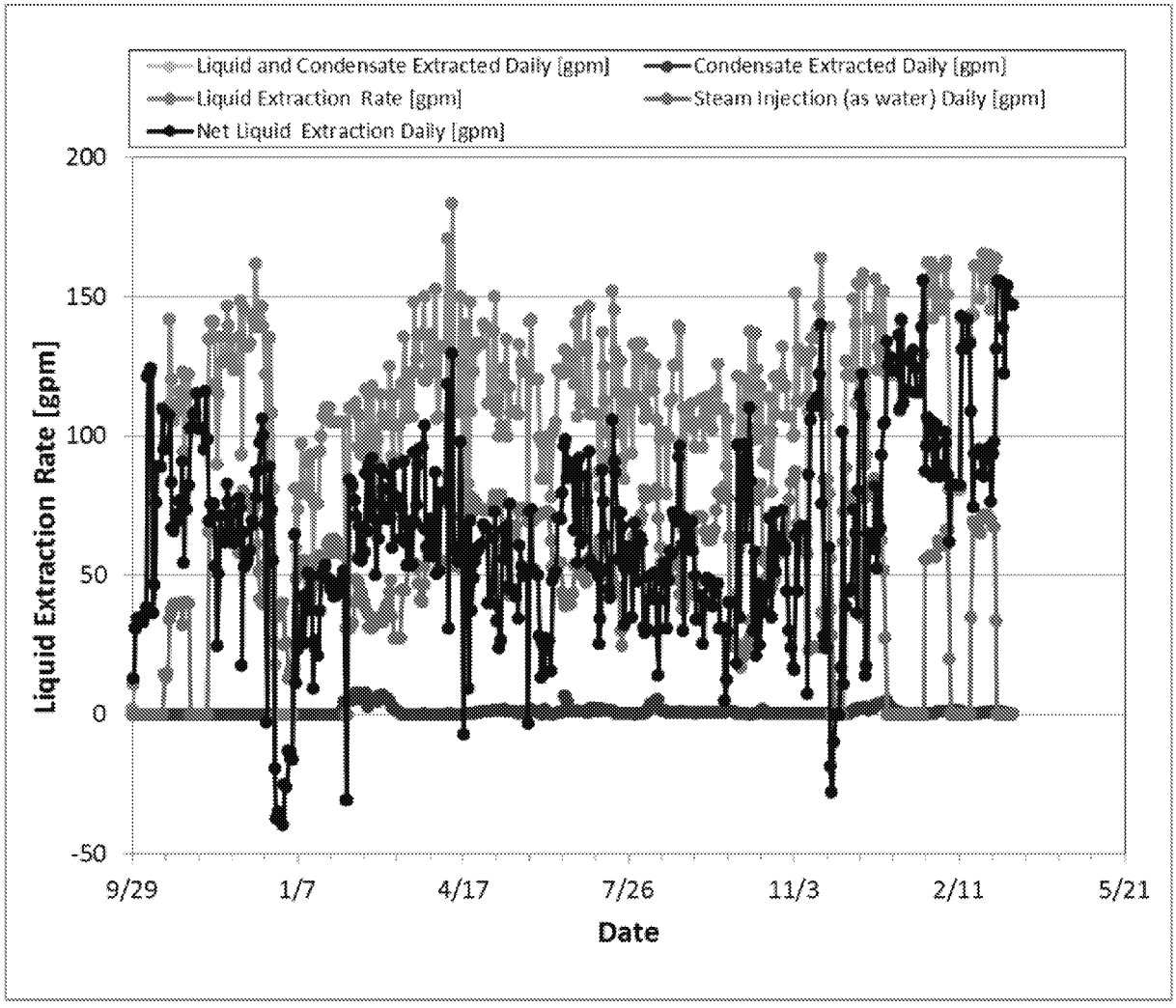

Figure 19. Water Balance Rates

15. Cumulative Energy Balance

The cumulative energy balance for the site is shown below. The energy balance has been updated to include calculated heat losses that are a combination of heat lost below the TTZ, above the TTZ and outside the TTZ. The heat losses were calculated according to the following approach:

- Based on the original SEE model, cumulative modeled heat losses were calculated for each operational phase (i.e., heat up, pressure cycling);
- The heat losses were compared to the cumulative energy added as steam for each operational phase;
- The percent of total steam energy "lost" was calculated by comparing modeled heat losses to modeled steam injection;
- Since the actual steam injection rates at ST012 have been different than originally modeled, the percent heat loss calculated for each operational phase in the model was applied to the actual steam injected to get the calculated heat losses during operation; and,
- The calculated heat losses were subtracted from the net energy injection to calculate the net energy injected with heat losses.

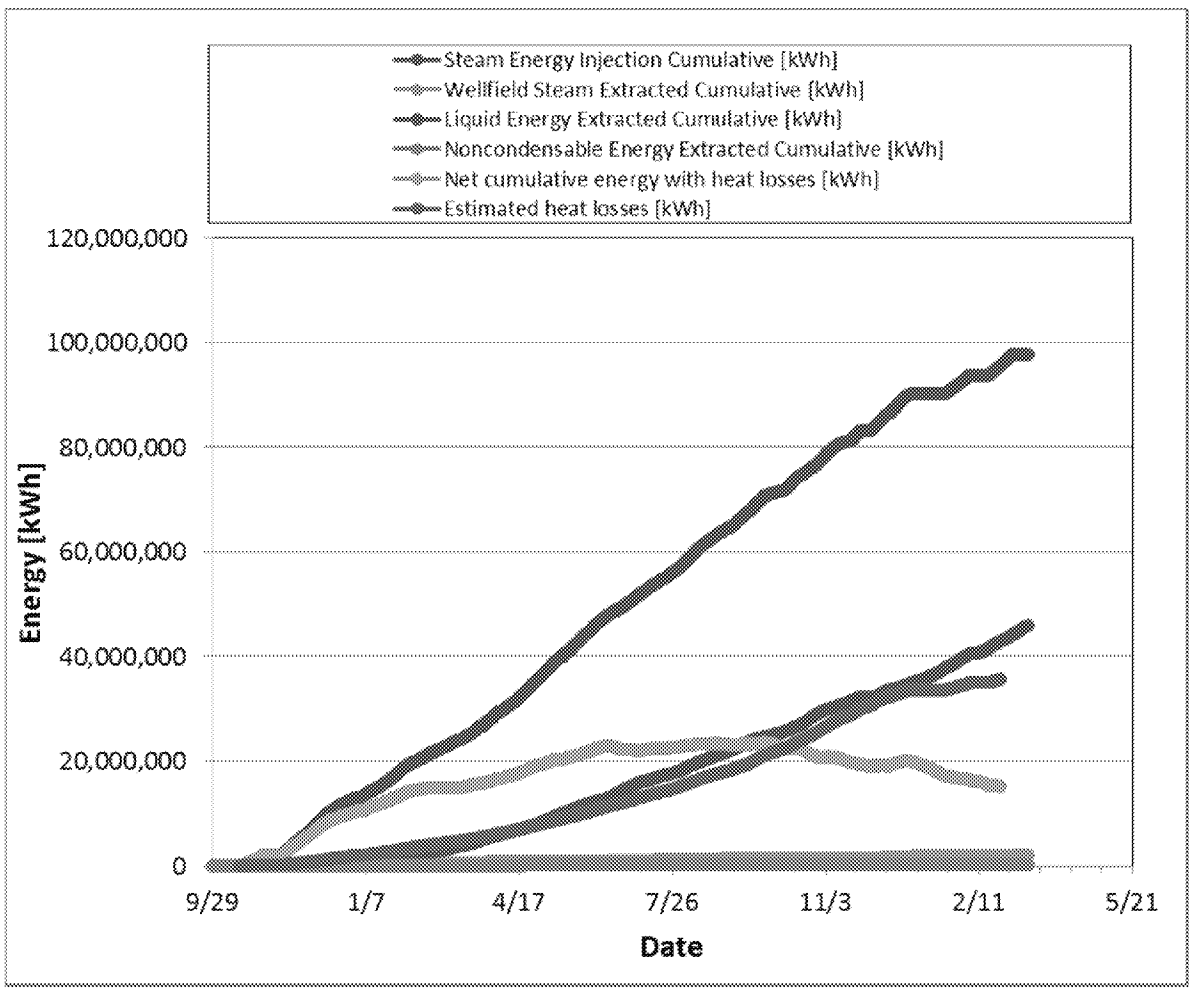

Figure 20. Cumulative Energy Balance

16. Energy Balance Rates

The energy balance rates are shown below.

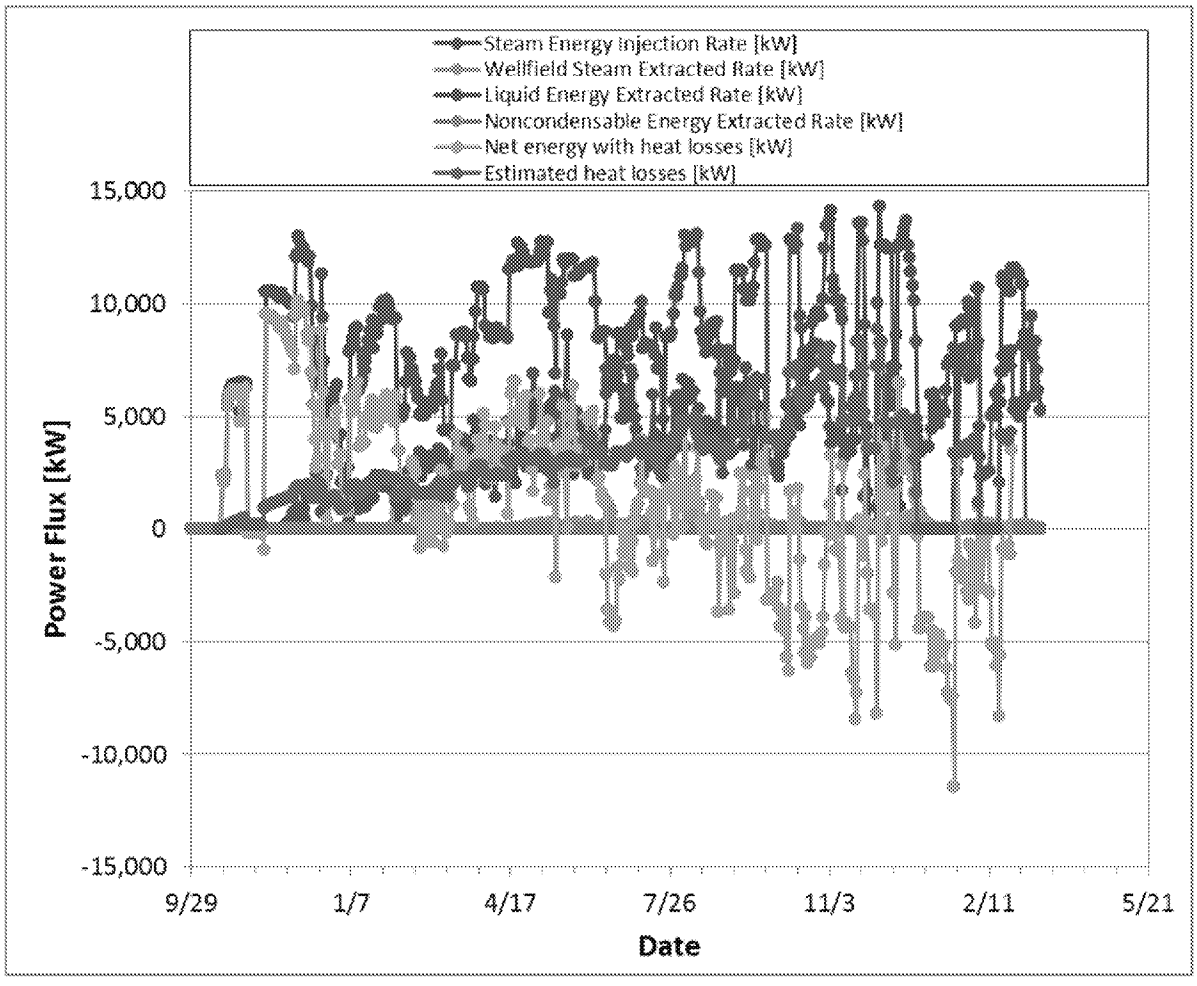

Figure 21. Energy Balance Rates

17. Perimeter Water Level Data

Table 4 below presents the change in perimeter groundwater elevations since SEE system startup. The readings collected on September 24, 2014 (not shown) represent baseline conditions. A negative number shows that the groundwater elevation is lower than the baseline elevation, thus indicating an inward hydraulic gradient into the treatment zone. Liquid extraction began on September 29, 2014. Perimeter water level data are collected on a weekly basis. The regional groundwater table at the Site is increasing at a rate of approximately 1.5 ft/year; thus, each measured value shown in Table 4 has been corrected to take the regional changes into account.

Table 4. Perimeter Groundwater Elevation Changes

	2/19/2016		2/26/2016		3/4/2016		3/11/2016	
Monitoring Well	Change from Baseline	Change from Previous	Change from Baseline	Change from Previous	Change from Baseline	Change from Previous	Change from Baseline	Change from Previous
CZ/UWBZ Wells								
ST012-C01	-1.82	-0.14	-1.73	0.12	-1.45	0.30	-1.62	-0.14
ST012-C02	-1.96	-0.28	-1.37	0.62	-0.88	0.52	-1.60	-0.70
UWBZ Wells								
ST012-RB-3A	-3.62	-0.42	-1.09	2.56	-0.48	0.64	-3.33	-2.83
ST012-U02	-2.92	-0.34	-1.11	1.84	-0.35	0.79	-2.24	-1.87
ST012-U11	-4.15	-0.31	-1.59	2.59	-1.19	0.43	-4.49	-3.28
ST012-U12	-5.27	-0.24	-1.40	3.90	-0.79	0.64	-5.36	-4.55
ST012-U37	-6.31	-2.25	-0.99	5.35	-0.36	0.66	-4.59	-4.21
ST012-U38	-0.84	1.17	-1.31	-0.44	-0.31	1.03	-1.91	-1.58
LSZ Wells								
ST012-W11	-5.37	0.69	-3.38	2.02	-3.73	-0.33	-6.60	-2.84
ST012-W12	-5.08	0.09	-2.37	2.74	-2.60	-0.20	-5.94	-3.32
ST012-W24	-4.20	-0.10	-2.04	2.19	-2.43	-0.36	-4.98	-2.53
ST012-W30	-4.80	0.32	-2.90	1.93	-2.07	0.86	-5.94	-3.85
ST012-W34	-3.85	-0.06	-1.77	2.11	-1.99	-0.19	-4.57	-2.56
ST012-W36	-3.65	0.18	-0.26	3.42	-0.48	-0.19	-4.67	-4.17
ST012-W37	-6.00	-0.20	-3.46	2.56	-3.74	-0.25	-5.35	-1.57
ST012-W38	-3.51	-0.18	-1.62	1.92	-1.69	-0.04	-4.04	-2.33

Figure 22 shows the manually collected groundwater elevation trends since system startup. Additionally Figure 23 shows the groundwater elevations continuously logged in selected perimeter wells equipped with transducers. The regional groundwater table correction has also been applied to Figure 22 below.

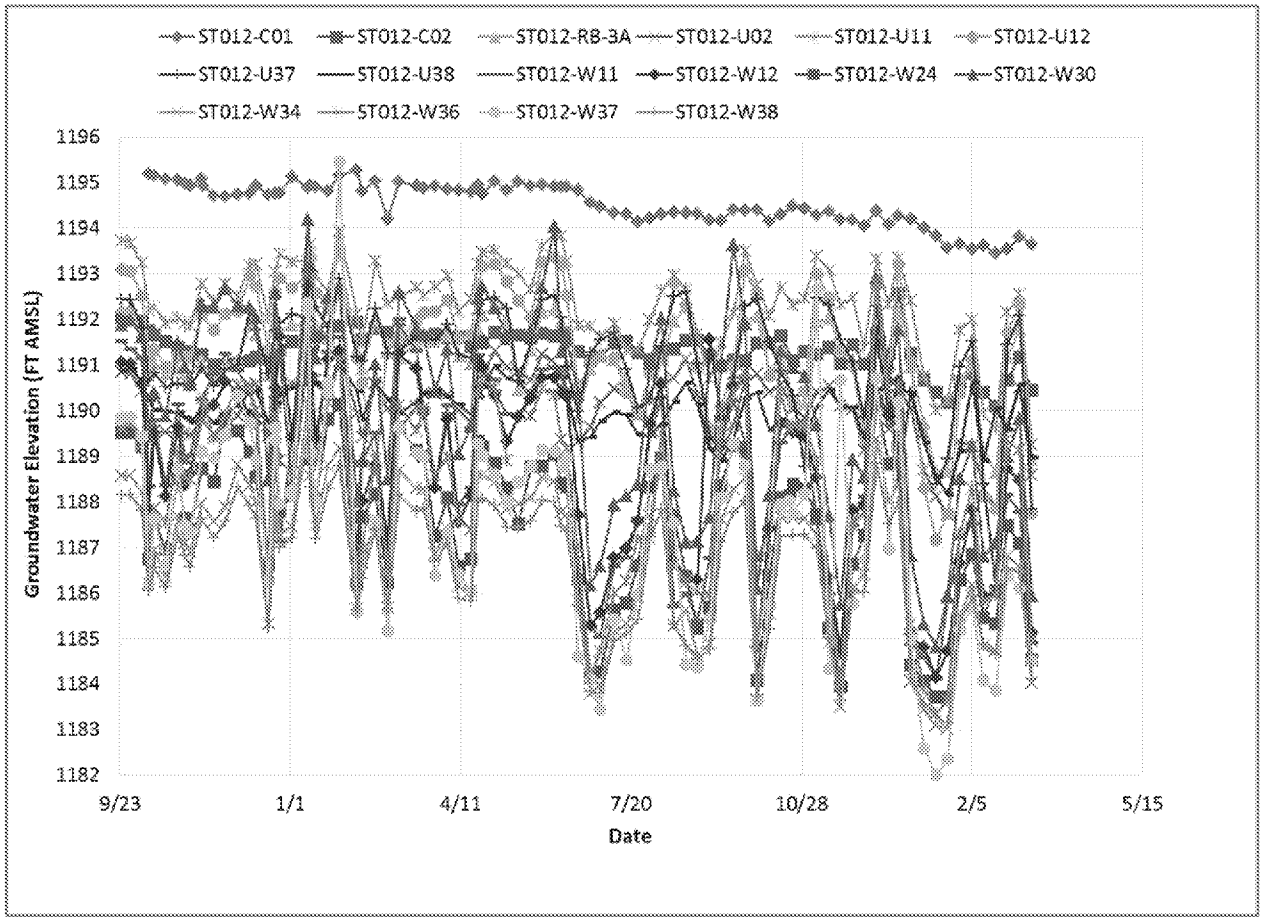

Figure 22. Manually Collected Perimeter Groundwater Elevations

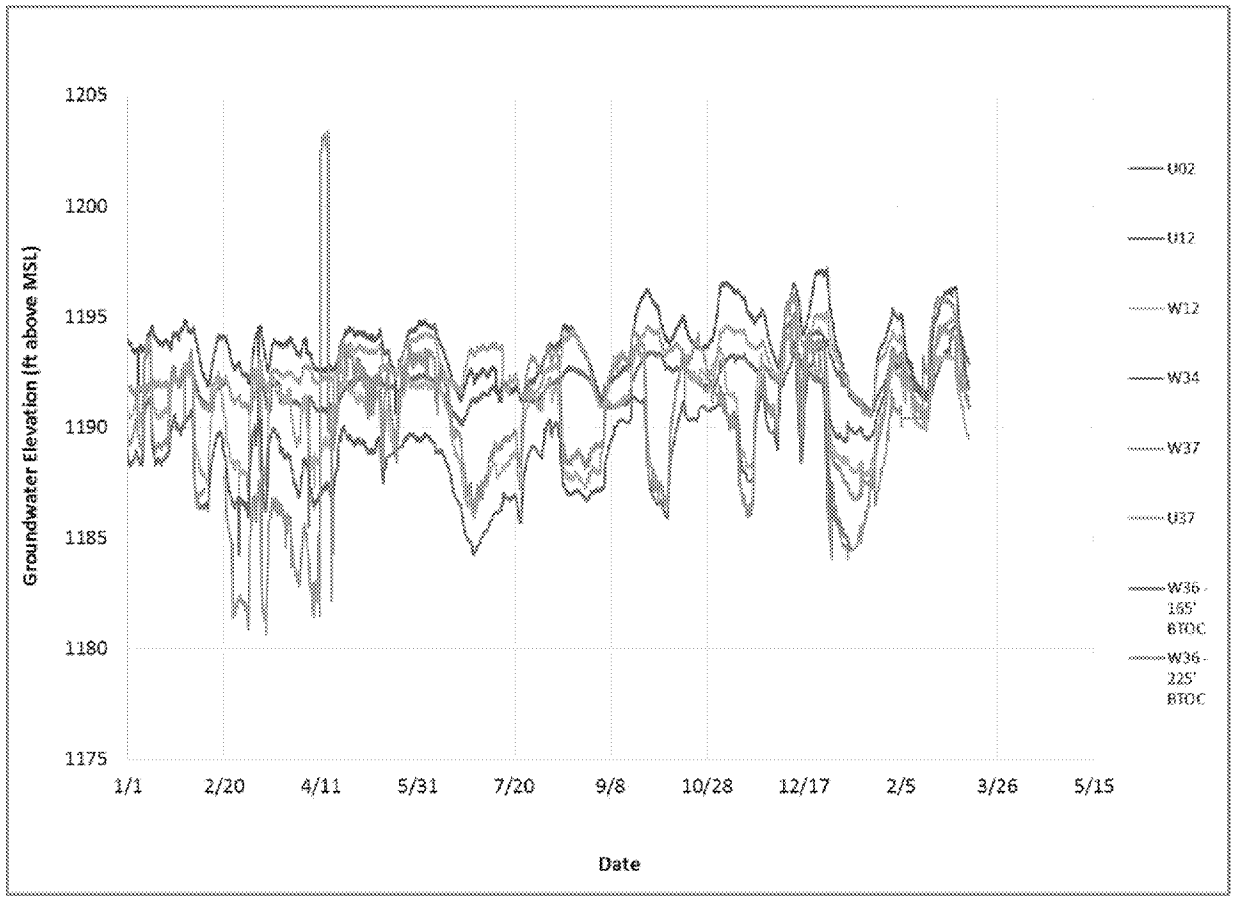

Figure 23. Automatically Collected Perimeter Groundwater Elevations

Table 5 below presents the measured LNAPL thicknesses of the perimeter wells at the site. Perimeter LNAPL thickness data are collected on a weekly basis.

Table 5. Perimeter LNAPL Thicknesses (ft)

Monitoring Well	2/19/2016			2/26/2016			3/4/2016			3/11/2016		
CZ/UWBZ Wells	Before bailing/ pumping	After Bailing/ pumping	Weekly Gallons Removed[1]	Before bailing/ pumping	After Bailing/ pumping	Weekly Gallons Removed[1]	Before bailing/ pumping	After Bailing/ pumping	Weekly Gallons Removed[2]	Before bailing/ pumping	After Bailing/ pumping	Weekly Gallons Removed
ST012-C01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ST012-C02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UWBZ Wells												
ST012-U02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ST012-U11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ST012-U12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ST012-U37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ST012-U38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ST012-RB-3A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LSZ Wells												
ST012-W11	6.06	6.06	0.00	6.87	3.66	2.00	5.28	5.28	0.00	5.53	5.53	0.00
ST012-W12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ST012-W24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ST012-W30	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00
ST012-W34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ST012-W36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ST012-W37	23.04	5.88	15.48[2]	28.40	1.50	17.56	8.42	8.42	0.00	35.89	1.40	22.51
ST012-W38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes:

[1]Estimated gallons removed based on 4-inch casing and difference in product level in well before and after removal. Does not account for volume of hose or other equipment in the column of product. Includess all dates bailed/pumped in the week.

[2]In addition to the weekly measurements, ST012-W37 LNAPL levels were measured and LNAPL was pumped on 2/10/16 and 2/15/16

On December 1, 2014, temperatures at selected perimeter wells were added to the monitoring program. Figure 24 below shows the manually collected temperatures recorded at the wells included in the monitoring program. Additionally, Figure 25 shows the temperatures continuously logged in selected perimeter wells equipped with transducers.

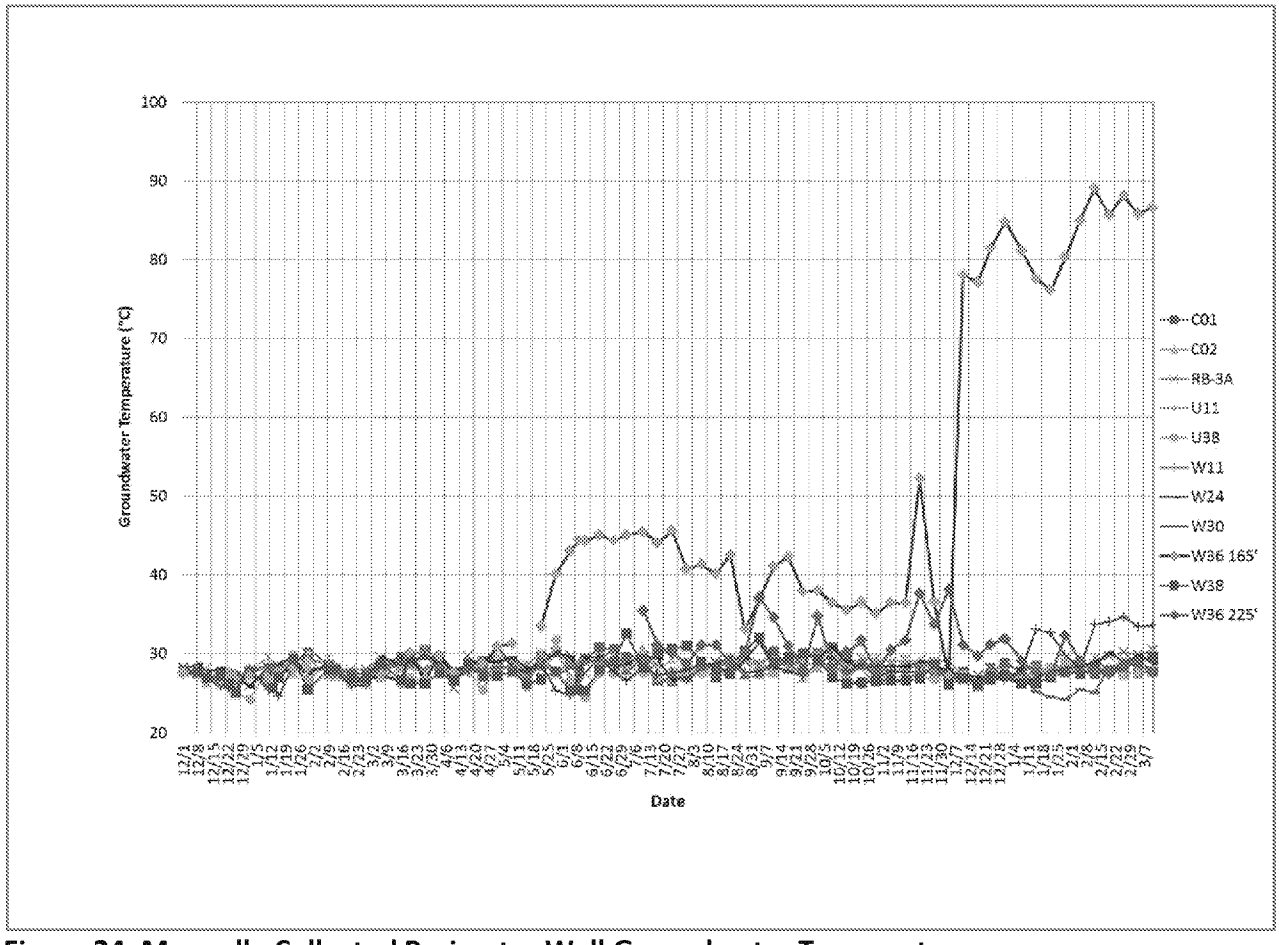

Figure 24. Manually Collected Perimeter Well Groundwater Temperatures

Note: Thermocouples are measured at approximate depths as follows (in feet below top of casing): C01=162; C02=168; RB-3A=161; U11=180; U38=164; W11=228; W24=230; W30=231; W36=225; and W38=228.

As a response to the increased temperatures observed at W36 on December 12, 2015 steam at nearby UWBZ9 and UWBZ25 were decreased.

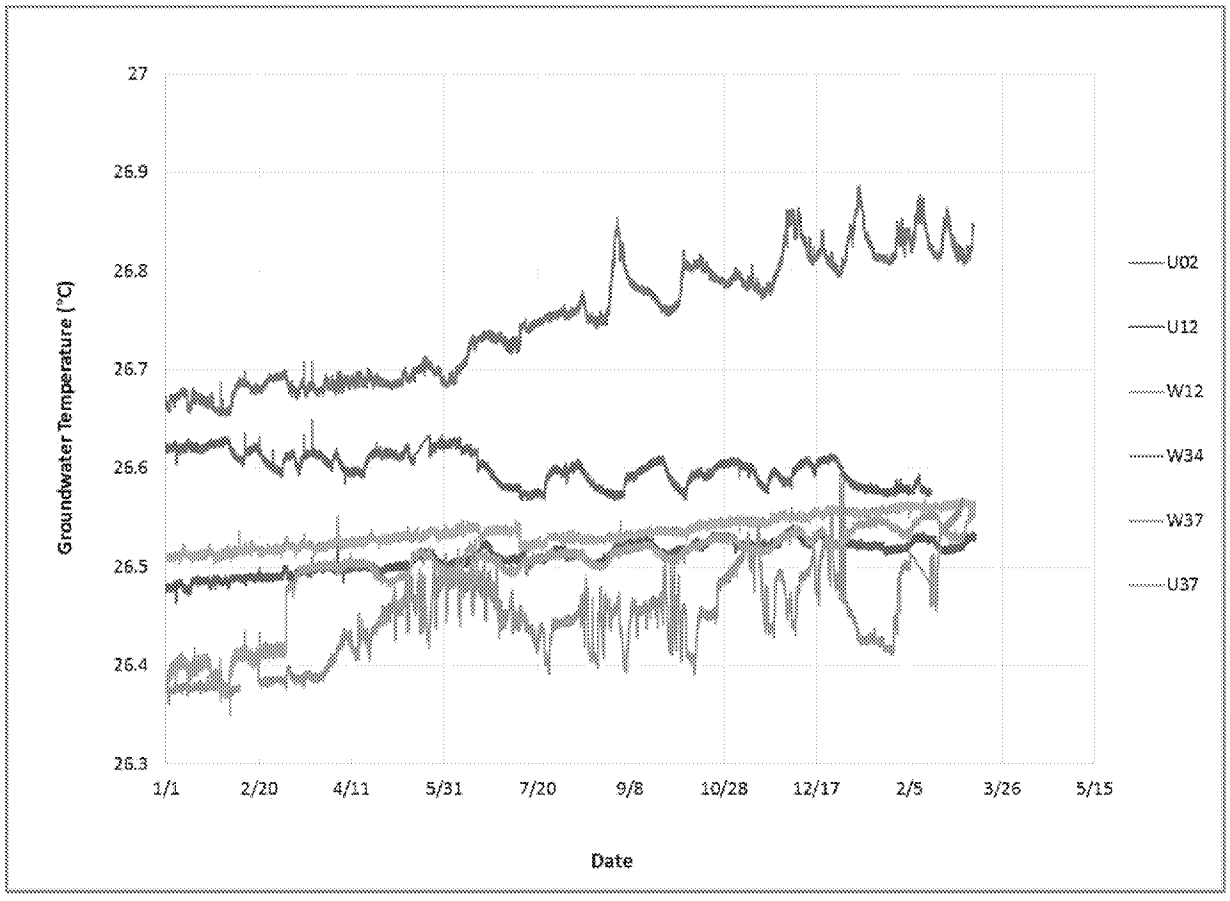

Figure 25. Automatically Collected Perimeter Well Groundwater Temperatures

Notes:
On March 7, 2015 operational personnel replaced the U37 logger unit. The increase in temperature on March 7, 2015 at U37 is a result of this replacement.

Transducers are measured at depths as follows (in feet below top of casing): U02= 175; U12= 175; U37= 182; W12= 228; W34= 225; and W37= 226.

Please note that the temperature data for W37 presented in last week's report was found to be incorrect data due to a temperature logger issue. The issue has been resolved for the logger at W37.

18. Natural Gas Usage

The following figure shows the natural gas usage rate in cubic feet per hour (cf/hr) and cumulative natural gas use in cubic feet (cf) to date at the site.

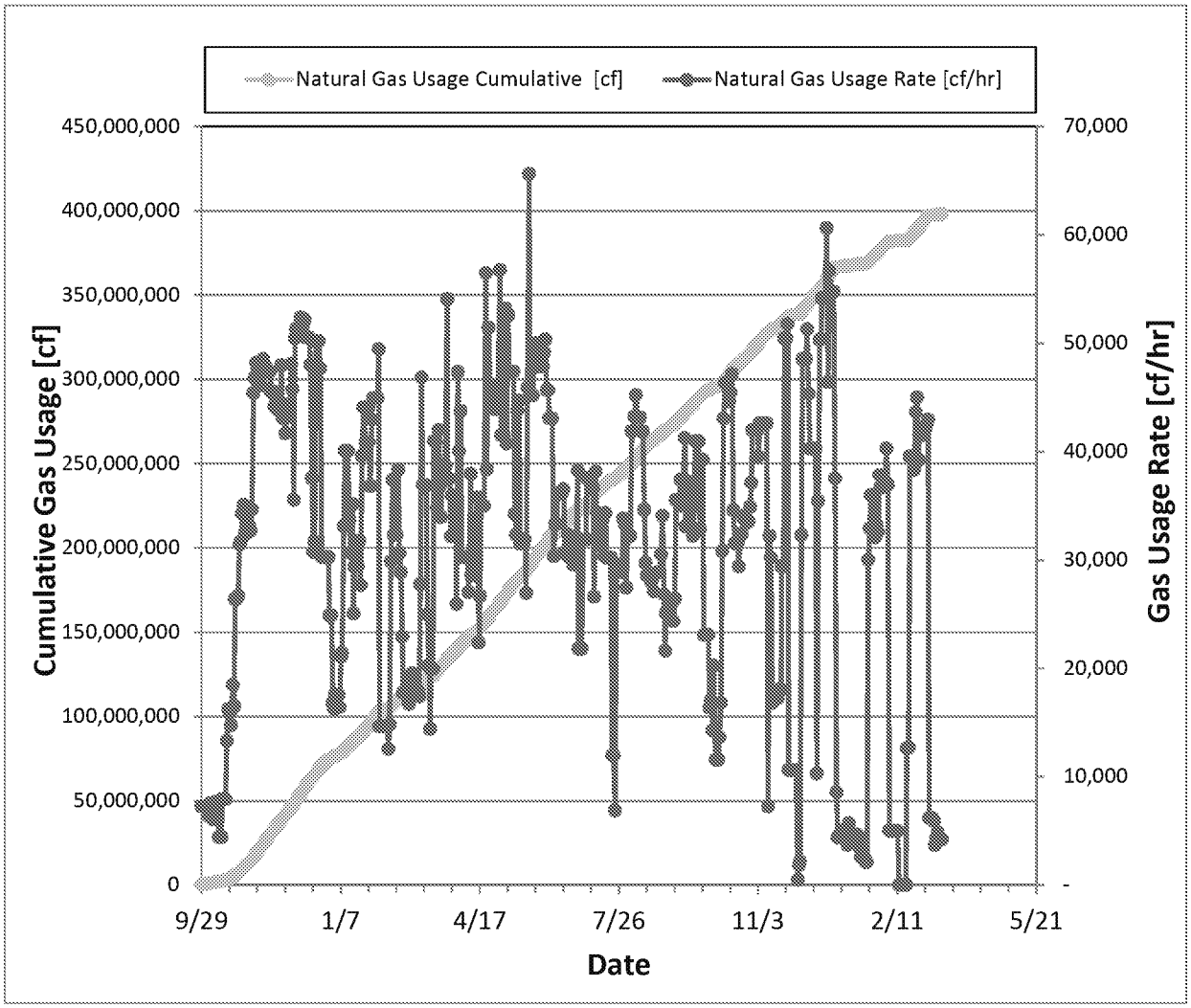

Figure 26. Natural Gas Usage

19. Waste Generation

On January 19, 2015 a total of 8,033 gallons of material from tank cleanout activities was removed from the site by Mesa Oil for recycling. The mass of JP-4 in the material was estimated to be 2,857 gallons or 18,800 lbs.

On February 18 and 19, 2015 a total of 24,430 gallons of material from tank cleanout activities was removed from the site by Mesa Oil for recycling. The mass of JP-4 in the material was estimated to be 3,645 gallons or 23,984 lbs.

On March 12, 2015 a total of 11,359 gallons of predominantly water from tank cleanout activities was removed from the site by Mesa Oil for recycling. The JP-4 mass in the water was limited.

On March 20, 2015 the first shipment of bag filters (four cubic yard boxes) from the SEE process treatment system was shipped offsite for non-hazardous disposal.

On March 30 and 31, 2015 a total of 32,000 lbs of spent liquid carbon was removed from the site by Evoqua Water Technologies for regeneration at their Red Bluff, CA facility.

On April 24, 2015 a shipment of bag filters (three cubic yard boxes) from the SEE process treatment system was shipped offsite for non-hazardous disposal.

On May 29, 2015 a shipment of bag filters (four cubic yard boxes) from the SEE process treatment system was shipped offsite for non-hazardous disposal.

On June 11, 2015 three 55-gallon drums of soil dug from around the Hypro NAPL filter were shipped offsite for non-hazardous disposal.

On June 10, 2015 a total of 5,727 gallons of oily bio-impacted water from tank cleanout activities was removed from the site by Mesa Oil for recycling.

On June 25, 2015 a shipment of bag filters (four cubic yard boxes) from the SEE process treatment system was shipped offsite for non-hazardous disposal.

On August 19, 2015 a total of 16,000 lbs of spent liquid carbon was removed from the site by Evoqua Water Technologies for regeneration at their Red Bluff, CA facility.

On August 27, 2015 a total of five totes with approximately 250 gallons each of water/solids from disinfection of the liquid carbon vessel were removed from the site by MP Environmental for disposal.

On October 22, 2015 a shipment of bag filters (four cubic yard boxes) from the SEE process treatment system was shipped offsite for non-hazardous disposal.

On November 23, 2015 a shipment of bag filters (four cubic yard boxes) from the SEE process treatment system was shipped offsite for non-hazardous disposal.

On December 31, 2015 a shipment of bag filters (four cubic yard boxes) from the SEE process treatment system was shipped offsite for non-hazardous disposal.

On February 1, 2016 a shipment of bag filters (four cubic yard boxes) from the SEE process treatment system was shipped offsite for non-hazardous disposal.

On March 10, 2016 a shipment of bag filters (four cubic yard boxes) from the SEE process treatment system was shipped offsite for non-hazardous disposal.

20. NAPL Reuse

On April 7, 2015 a total of 12,647 gallons of stored NAPL was sent to Mesa Oil for reuse. The analysis showed that 703 gallons of the total fluid was water. The water has been subtracted from the NAPL recovery estimate.

On April 21-22, 2015 a total of 13,076 gallons of stored NAPL was sent to Mesa Oil for reuse. Analysis showed a water content between <1% to 3% or a total of 227 gallons of water. The water removed has been subtracted from the NAPL recovery estimate.

On May 7, 2015 a total of 5,722 gallons of stored NAPL was sent to Mesa Oil for reuse.

On May 21, 2015 a total of 1,400 gallons of stored NAPL was sent to Mesa Oil for reuse.

On June 24, 2015 a total of 6,771 gallons of stored NAPL was sent to Mesa Oil for reuse.

21. Estimated Formation Water Temperature

The estimated formation water temperatures are indicated in Table 6 below. The formation water temperatures have been estimated for each MPE well by measuring the eductor liquid feed and return flow rate together with the eductor liquid feed and return temperatures. The enthalpy increase in the liquid return temperature as compared to the liquid feed stream temperature is used to provide the MPE well specific formation temperature. Estimated formation water temperatures above the boiling point likely indicate that steam is being pulled into the liquid extraction system. These estimated data for each MPE well location are used in conjunction with the extracted vapor data collected at the MPE wells to make determinations on steam breakthrough around the site. All of these data are reviewed holistically (with other site data such as the TMP data) to determine when and where steam cycling events should commence.

The location of each MPE well is also indicated in the table. Since perimeter extraction wells are expected to extract colder water from outside of the treatment zone, the formation temperature at these locations is not expected to reach steam temperatures. Thus, full or partial steam breakthrough can still be occurring at the perimeter locations without the estimated formation water temperature being at boiling. Please note that if the estimated formation water temperature is higher than 220°C for a given well, ">220" is indicated in the table.

Please note that no vapor temperature data were collected from the MPE wellheads November 5-13, 2015 due to issues with the temperature equipment.

Table 6. Estimated Well Formation Temperatures

					MPE Formation Temperatures																				
Well	Well	Required to Reach	Reached Steam	Vapor Extraction	1/5/16	1/7/16	1/12/16	1/14/16	1/18/16	1/20/16	1/22/16	1/26/16	1/28/16	2/2/16	2/4/16	2/11/16	2/15/16	2/17/16	2/19/16	2/24/16	2/26/16	3/1/16	3/3/16	3/7/16	3/9/16	3/11/16	3/14/16
	Location	Steam Temperature	Temperature (Calculated)	Max Temperature [°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]
CZ07	Perimeter	No	Yes	158	205	209	206	201		202	218	155	208	>220	>220	212	104	105	100	>220	8	>220	>220	>220	>220	218	>220
CZ08	Perimeter	No	Yes	192	>220	201	196	172		>220	218	122						8		>220							
CZ09	Perimeter	No	Yes	105	131		161	147	167	197	161	107	160	123	139	76	126	>220	86	123	97	186	149	134	125	153	139
CZ10	Perimeter	No	Yes	206	185	186	188	198		162	176	195	196	201	>220	170	50	50	55	186	71	>220	198	186	178	169	187
CZ11	Interior	Yes	Yes	217																						
CZ12	Perimeter	No	Yes	220	146	179	196	154	186	186	>220	136	>220	>220	>220	205	186	218	35	191	212	>220	>220	>220			
CZ13	Perimeter	No	Yes	160	>220	198	188	182		194	200	111	>220	>220	>220	83		45	80	>220	172	>220	>220	>220	>220	213	206
CZ14	Perimeter	No	Yes	112	171	131	156	150	186	177	>220	112	204	216	>220	186	96	96		>220		>220	>220	216	>220	206	181
CZ15	Interior	Yes	Yes	170	204	208	193	191	211	182	212	102	>220	>220	>220	190	100	101	116	>220	134	>220	>220	>220	>220	201	137
CZ16	Perimeter	No	Yes	212				>220	>220	>220	>220	>220	>220	>220	>220	216	82	84	73	>220	>220	>220	>220	>220	>220	203	>220
CZ17	Perimeter	No	Yes	200	201	181	177	175	182	190	196	104	>220	>220	>220				111	209	110	191	>220	219	205	180	197
CZ18	Perimeter	No	Yes	208	>220	203					116	>220	204	>220	200	88	158	182	79	167	93	152	165	142	143	170	120
CZ19	Perimeter	No	Yes	110	194	174	173	185	180	165	>220	133	209	182	>220	184	107	106	95	198	191	207	219	188	>220	213	207
CZ20	Outside CZ	No	No	111	88			38	0	100	89	121	99	102	95	91		71	67		88	101	87	86	82	113	86
LSZ01	Interior	Yes	Yes	126	191	209	211	152	179	193	212	181	201	206	>220	122	137	136	80	195	198	191	197	137	170	195	167
LSZ02	Interior	Yes	Yes	130	200	>220	157	>220	186	>220	199	182	173	181	192	74	>220	>220	116	195	66	181	193	188	180	183	168
LZS04	Interior	Yes	Yes	206																							
LSZ05	Interior	Yes	Yes	220					>220	>220	>220	126	>220	>220	>220	207	149	149	130	>220	77	>220	>220	>220	>220	215	203
LSZ06	Interior	Yes	Yes	218							>220	>220	>220	>220	>220	>220	124	124	177	207	188	177	>220	189	>220	>220	>220
LSZ08	Perimeter	No	Yes	120	133	159	113	139		143	123	105	147	155	160	138	152	143	82	130	63	122	130	124	138	143	132
LSZ11	Perimeter	No	Yes	119								103	102	92	96		44			94			97				
LSZ12	Perimeter	No	Yes	126	192	194	173	182	94	174		113	174	187	181	153	126	128	97	164	164	126	176	154	180	157	123
LSZ13	Interior	Yes	Yes	125	173	190	191	191	192	184	194	>220	193	150	167	>220	210	209	33	178	139	>220	198	133	215	218	202
LSZ14	Perimeter	No	Yes	177	215	>220	196	189	191	191		165	199	197	196	171	125	123	68	207	169	196	185	168	158	143	165
LSZ15	Interior	Yes	Yes	208	183	>220	>220	>220	>220	>220	>220	152	>220	>220	>220		120	108	135	210	193	205	202	209	196	202	205
LSZ16	Interior	Yes	Yes	205	>220	178	>220	>220	220	203	208	101	>220	200		188	92	89	28		48	205	199	178	170	175	137
LSZ17	Perimeter	No	Yes	220	102	108	97	97		99	97	79	109	123	120	96	79	79	66	101	68	109	105	98	97	99	98
LSZ28	Perimeter	No	Yes	129	>220	>220	197	>220		160	155	121	197	172	189	175	68	68	76	175	4	176	168	172	148	151	172
LSZ29	Perimeter	No	Yes	116	214	181	201	218	>220	195	202	111	188	194	208	115	177	163	>220	>220	>220	149	194	186	211	215	211
LSZ30	Interior	Yes	Yes	133	>220	>220		177	>220	>220	>220	>220	>220	>220	>220	>220	>220	219		>220	77	>220	>220	218	>220	210	164
LSZ31	Interior	Yes	Yes	147	>220	>220	>220	>220	194	>220	209	>220	207	189	>220	151	108	71		91	95	>220	>220	175	185	182	181
LSZ32	Interior	Yes	Yes	120	159	96	91	187	199	191	199	156	220	216	>220		76	86		206	186	216	>220	195	>220	>220	214
LSZ33	Perimeter	No	Yes	130		189	>220	>220	>220	>220		173	>220	>220	>220		>220	>220	35	>220	197	>220	>220	189	198	197	184
LSZ34	Interior	Yes	Yes	168	220	>220	>220	194	>220	>220	>220	142	114						47	177	166	183	177	174	168	170	173
LSZ35	Perimeter	No	Yes	121	128	111	111	126	108	122		80	119	113	115	111	115	115	118	110	108	117	112	102	103	108	106
LSZ36	Perimeter	No	Yes	128	182	179	169	171	181	169		101	158	147		125	85	85	59	150	145	143	139	139	129	139	101
LSZ37	Perimeter	No	Yes	208		113	77	101	105	109	123	94	139	158	155	117	87	90	76	151	152	174	170	119	152	109	170
LSZ38	Perimeter	No	Yes	116	152	193	158	208	>220		>220		159	>220		99	60	58	72	157	131	154	148	143	148	144	134
LSZ39	Perimeter	No	No	118		117	130		12	165	209	126	187	146			185		18	122		120	116	148	131	124	121
LSZ40	Interior	Yes	Yes	135		55	92	198	91	209	>220	>220	>220	>220		>220	121		113		213	220	>220	210	195	194	188
LSZ42	Perimeter	No	Yes	130	>220	>220		>220	>220	>220		>220	>220	>220		178	103	102	72	179	167	180	177	172	177	128	158

MPE Formation Temperatures																								
Well	Well	Required to Reach	Reached Steam	Vapor Extraction	1/5/16	1/7/16	1/12/16	1/14/16	1/18/16	1/20/16	1/22/16	1/26/16	1/28/16	2/2/16	2/4/16	2/11/16	2/15/16	2/17/16	2/19/16	2/24/16	2/26/16	3/1/16	3/3/16	3/7/16	3/9/16	3/11/16	3/14/16
	Location	Steam Temperature	Temperature (Calculated)	Max Temperature [°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]	[°F]
UWBZ01	Interior	Yes	Yes	150	>220	>220	>220	146	>220	>220	>220	208	>220					56	43	193	176	211	188	208	170	174	142
UWBZ02	Interior	Yes	Yes	210				86	90	91	>220	>220	>220	>220	>220	>220		98	99	138	>220	73	>220	>220	>220	>220	>220	>220
UWBZ04	Interior	Yes	Yes	201	>220	>220	>220	>220		246	>220	124	>220	>220	>220	>220	108		101	>220	146	>220	>220	>220	>220	>220	>220	>220
UWBZ05	Interior	Yes	Yes	220							216	>220	>220	>220	>220		196		46	>220			>220	210	216	187	166
UWBZ06	Interior	Yes	Yes	165	107	115	107	109	107	101	106	115	147	164	175	169	120	119	103	165	92	172	178	164	161	165	>220
UWBZ10	Perimeter	No	Yes	179	>220	115	>220	7		114	128	168	>220	>220	>220	186	189	161	59	>220	89	>220	>220	200	198	172	206
UWBZ17	Perimeter	No	Yes	220	>220	>220	>220	>220		215	>220	147	>220	>220	>220	>220	198	59	46	25	>220	63	>220	>220	>220	>220	>220	>220
UWBZ18	Interior	Yes	Yes	200	>220	>220	>220	>220			>220	188	>220	>220	>220	>220			122	>220	95	>220	>220	>220	>220	>220	>220
UWBZ19	Perimeter	No	Yes	162	>220	>220	>220	>220	>220	>220	>220	120	>220	>220	>220	154	121	120	69	201	98	>220	>220	>220	>220	>220	>220
UWBZ20	Dual Phase - Perimeter	No	No	112																96							
UWBZ21	Outside UWBZ	No	Yes	118	>220	>220	>220	219	196	206	202	>220	201	>220	>220	161	170	201	92	>220	>220	>220	>220	>220	>220	>220	185
UWBZ22	Perimeter	No	Yes	127	204	171	174	152	158	163	160	137	182	>220	205	>220	23	43	>220	192	190	218	>220	>220	190	169	127
UWBZ23	Outside UWBZ	No	Yes	206	>220	>220	>220	169	212	>220	>220	>220	>220					125	38	>220	>220	>220	>220	>220	>220	>220	>220
UWBZ24	Dual Phase - Perimeter	No	Yes	200	>220	>220	>220	146	>220	>220	>220	122	>220	>220	>220	>220	218	218	91	218	>220	>220	>220	>220	>220	>220	>220
UWBZ26	Outside UWBZ	No	Yes	105				150	127	159	118	154	130	152	165		132	131		150			167	138	110	133	160
UWBZ27	Outside UWBZ	No	Yes	115								163	156	200	144			52	100	166			133	113	114	111	109

RED : at or above steam temperature (≥210 °F)
GREEN : below steam temperature (<210 °F)

22. NAPL Screening Results and Calculated Benzene Concentrations

Figures 27-29 below present the screening level results for NAPL detected in samples collected from MPE wells across the site. Screening samples are typically collected on a weekly basis. The figures below also include calculated benzene concentrations of groundwater samples collected from MPE wells across the site. Data collected prior to January 5, 2016 are not shown in the figures below.

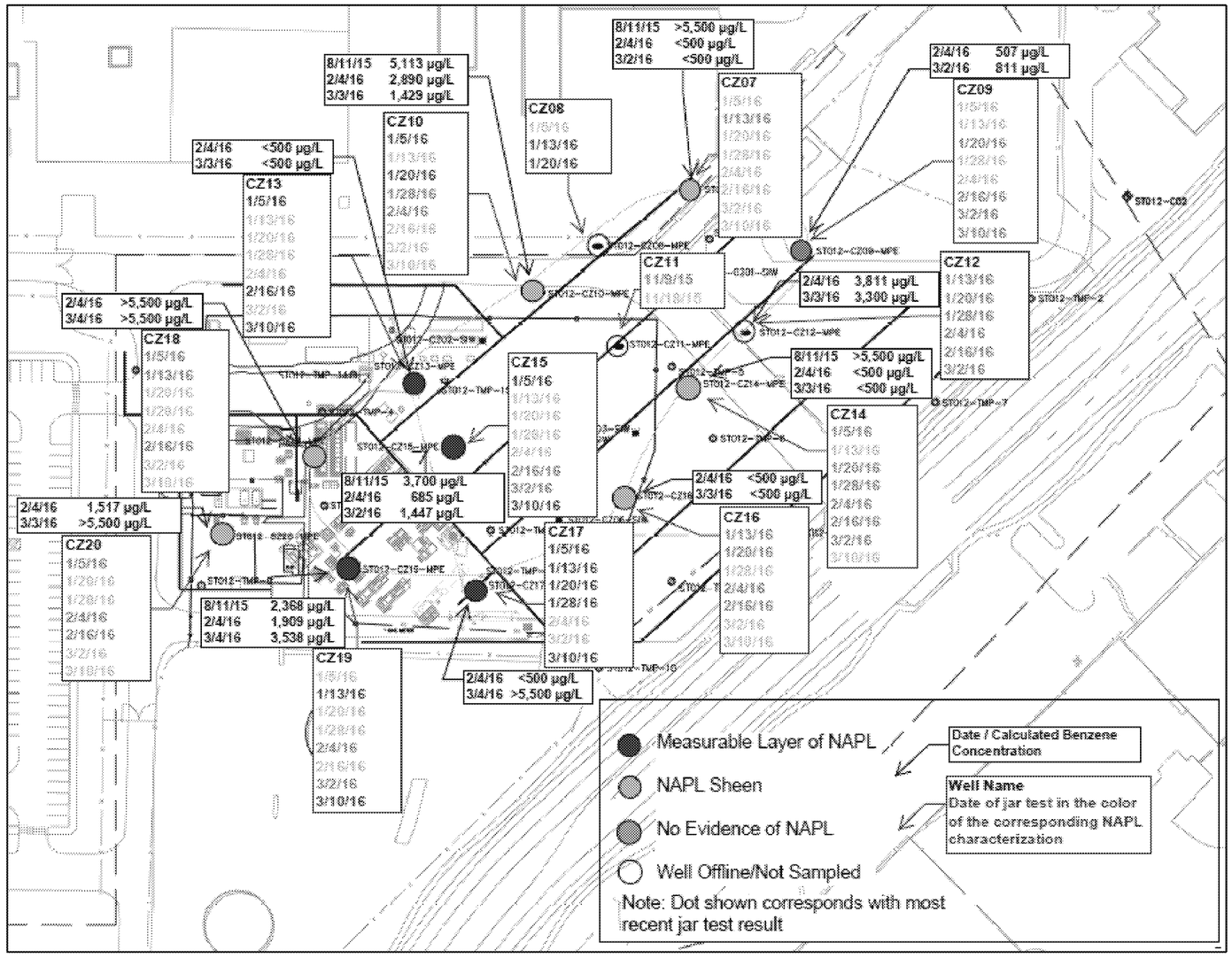

Figure 27. NAPL Screening Results and Calculated Benzene Concentrations – Cobble Zone

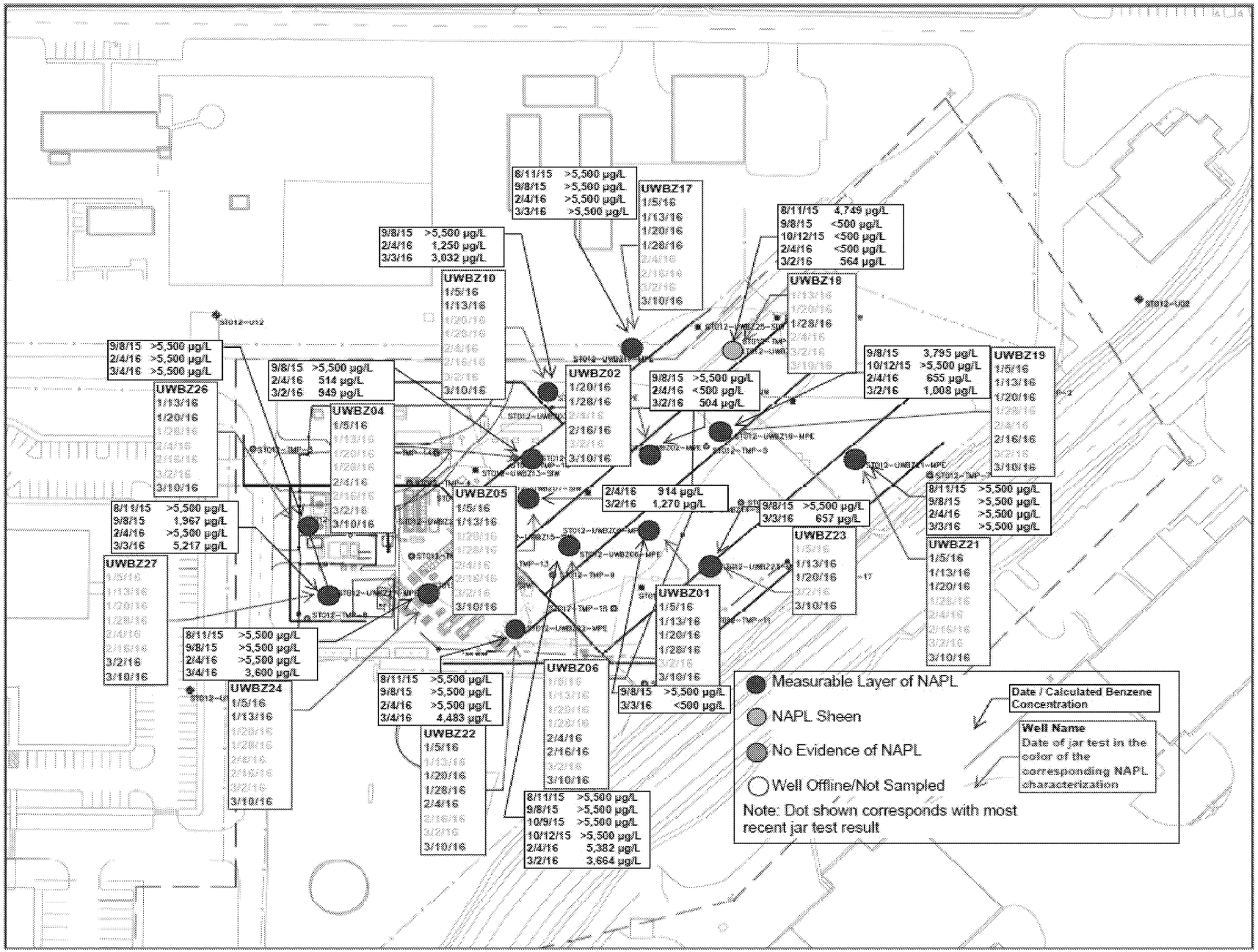

Figure 28. NAPL Screening Results and Calculated Benzene Concentrations – Upper Water Bearing Zone

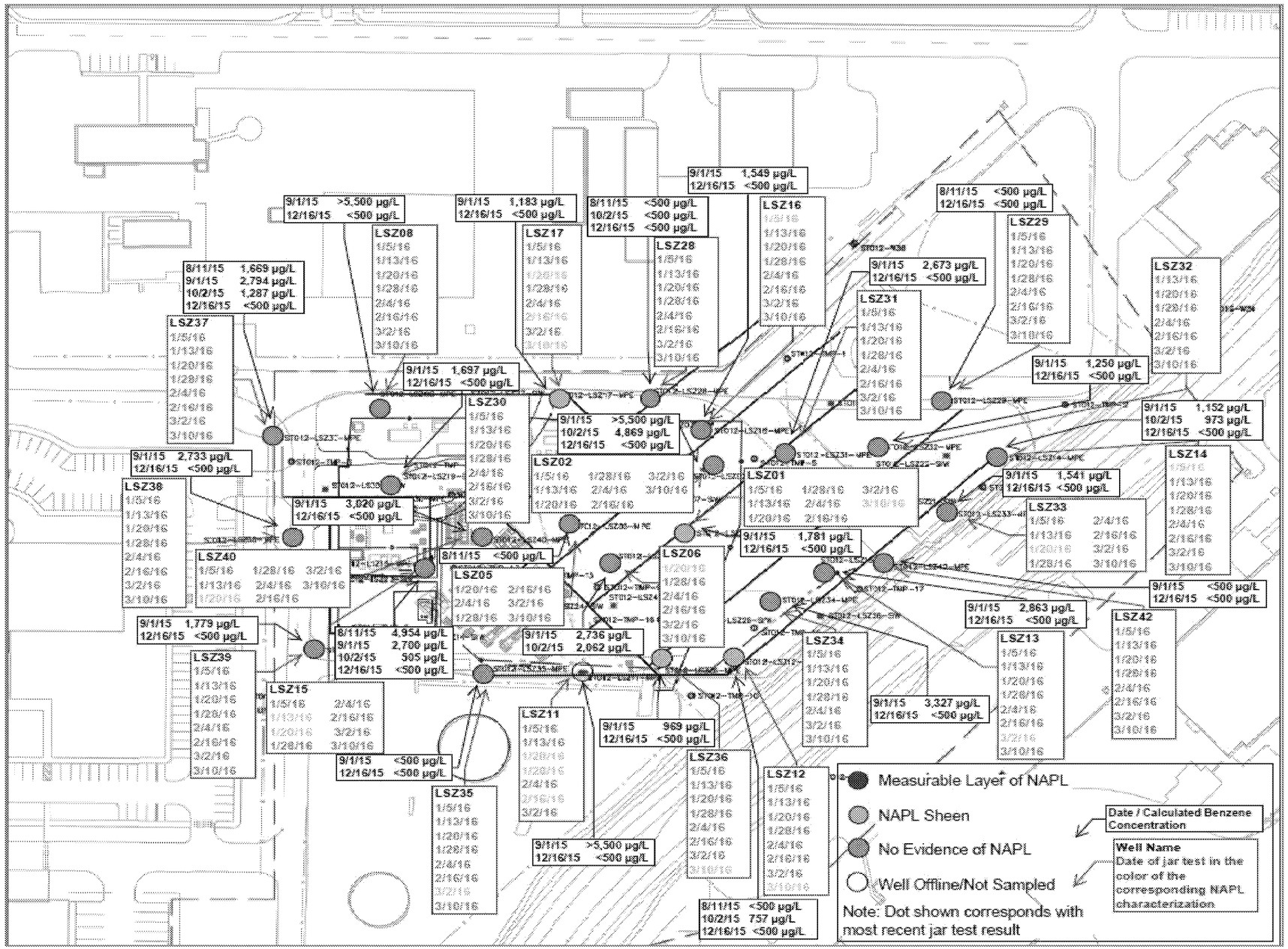

Figure 29. NAPL Screening Results and Calculated Benzene Concentrations – Lower Saturated Zone